Bulletin of the ATOMIC SCIENTISTS

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A MAGAZINE FOR SCIENCE, PUBLIC AFFAIRS, AND EDUCATION

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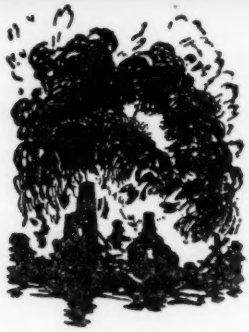
THE PRESIDENT ORDERS EXPLORATION OF THE SUPER BOMB



THE first disclosure of America's interest in the development of a "super-bomb" to come from any officially informed source, was made on November 1, 1949, by **Senator Edwin C. Johnson,** a member of the Joint Committee on Atomic Energy. Senator Johnson's comments came over a television network in the course of a debate, "Is There Too Much Secrecy in Our Atomic Program?" The Colorado senator was taking the side that there was not enough secrecy and deploring the scientists' "yen" to tell all they know. In answer to his opponent's question whether we would not be safe, now that the Russians have produced an atomic bomb, in taking off some of the restrictions and allowing a freer flow of information among American atomic workers, the Senator said:

"I'm glad you asked that question, because here's the thing that is top secret.

"Our scientists from the time that the bombs were detonated at Hiroshima and Nagasaki have been trying to make what is known as the super-bomb.

"They've been devoting their time to two things: one, to make a super-bomb, and the other, to find some way of detonating a bomb before the fellow that wants to drop it can detonate it. And we—we've made considerable progress in that direction.

"Now, there's no question at all the Russians have a bomb more or less similar to the bomb that we dropped at Nagasaki, a plutonium bomb.

"Our scientists are certain that they have that bomb, but it's not a better bomb than dropped at Nagasaki.

"Now, our scientists already have created a bomb that has six times the effectiveness of the bomb that was dropped at Nagasaki and they're not satisfied at all; they want one that has a thousand times the effect of that terrible bomb that was dropped at Nagasaki that snuffed out the lives of 50,000 people just like that.

"And that's the secret that's the big secret that the scientists in America are so anxious to divulge to the whole scientific world."

It was not until November 18th that Senator Johnson's televised remarks appeared in the press. On November 25th the President summoned Attorney General McGrath and Senator Brien McMahon, Chairman of the Joint Committee, to demand that unauthorized disclosures be prevented. On December 2nd details of the projected bomb began to be widely publicized through the syndicated column written by **Joseph and Stewart Alsop.**

On December 2nd the Alsop brothers said:

"A 1,000-power atomic bomb is more than a simple possibility.

"Its explosive power will derive from the nuclear fission of hydrogen, the lowest of the elements in the electron table, instead of uranium, at the top. The theory of how to make it is already understood and generally accepted. Making it will require immense efforts, yet the job is actually farther along than was the job of making the Hiroshima bomb when the Manhattan District was established.

"Furthermore, Senator Johnson's estimate of the probable power of the new bomb is also generally accepted. A Hiroshima bomb devastates an area of from two to four square miles. When constructed, the 1,000-power bomb will devastate an area a little more than thirty times as large, or from sixty to 100 square miles.

On January 2nd they gave further details:

"None of those now arguing the problem doubts for a moment that this hideous weapon will be built eventually. That will be taken care of by the ordinary work of the Atomic Energy Commission. The question is, rather, whether to appropriate the money and mobilize the manpower to build such a bomb in perhaps two, or three, or four years.

"Interestingly enough, the same issue was first debated immediately after the war, before the Atomic Energy Commission was set up. The theoretical possibility of a hydrogen bomb was as well understood then as now. A great effort to produce one was urged in certain quarters. President Truman then referred the problem, for study and recommendation, to Dr. Vannevar Bush and President Conant of Harvard.

"As reported by competent authority, Bush and Conant found, first, that the problem of building a hydrogen bomb was quite as big, complex, and difficult as the original problem of building the Hiroshima bomb. By the same token, they also found that the project would demand the same overriding priorities, the same mobilization of resources and manpower that made possible the success of the Manhattan District.

"At that time, there was no question about our monopoly of the uranium-plutonium bomb. The power-for-dollar return on the investment did not appear to justify a vast peace-time effort to produce a hydrogen bomb. Conant and Bush returned an adverse report."

On February 1, **President Truman** announced his decision concerning the development of the super-bomb in the following words:

"It is part of my responsibility as Commander-in-Chief of the armed forces to see to it that our country is able to defend itself against any possible aggressor.

"Accordingly, I have directed the Atomic Energy Commission to continue its work on all forms of atomic weapons, including the so-called super-bomb.

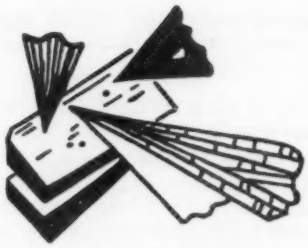
"Like all other work in the field of atomic weapons, it is being and will be carried forward on a basis consistent with the over-all objectives of our program for peace and security.

"This we shall continue to do until a satisfactory plan for international control of atomic energy is achieved. We shall also continue to examine all those factors that affect our program for peace and this country's security.

Two hours after the President's announcement the members of the Congressional Joint Committee on Atomic Energy went into a closed session with the Atomic Energy Commission to "discuss ways and means of proceeding." It was reported that the Joint Committee members were almost unanimous in support of the President's decision.

Editorial

SECRETS WILL OUT



AN ORDINARY gun shell consists of a detonator, usually a capsule of mercury fulminate—a chemical so unstable that it can be exploded by mechanical impact—and a main charge of a relatively more stable but still explosive material, such as black powder or trinitrotoluene (TNT). The fulminate is detonated mechanically, and its explosion ignites the main charge.

The same principle applies to nuclear reactions. Plutonium, like mercury fulminate, can be made to explode by purely mechanical means. Some elements, particularly among the lightest ones, or mixtures of such elements, are analogous to TNT or black powder: They are relatively stable, but calculations indicate that they should explode if ignited by a detonator producing a sufficiently high temperature.

These facts were familiar to nuclear scientists everywhere in the world, even before the discovery of uranium fission. However, there seemed to be no means whatsoever of creating the required high temperatures (several million degrees!) by any kind of detonator at man's disposal. This has been changed by the advent of the fission bomb. To combine a detonator of plutonium with a charge of light elements, thus creating a "super-bomb" (thermo-nuclear bomb) whose explosive power could be far in excess of that of the detonator alone—this dream, or nightmare, has been haunting nuclear physicists all over the world ever since the achievement of the fission bomb.

We print in this issue the translation of a chapter from a book written in 1946 by a distinguished Austrian physicist, Professor Hans Thirring, without access to any secret information.

The chapter describes the principle of the thermo-nuclear bomb and gives estimates of the energy which could be released in such a bomb, by two specific nuclear reactions: the conversion of two heavy hydrogen nuclei (deuterons, H 2) into a nucleus of light helium (He 3) and a neutron; and the reaction of a lithium nucleus (Li 7) with a hydrogen nucleus (proton, H 1), leading to the formation of two nuclei of ordinary helium (He 4).

For four years the *Bulletin* has faced the question whether or not to publish the article by Professor Thirring (or other articles on the subject of thermo-nuclear explosions which it could easily have obtained) to lend weight to the warnings of scientists that the plutonium bomb may be only the herald of other, more destructive atomic weapons. We have refrained from doing so, because we feared that any discussion of this subject in the *Bulletin* might foster the belief that America was actively engaged in developing thermo-nuclear weapons, and that this might stimulate the atomic arms race and further exacerbate international relations.

It was left to the naive and monumental indiscretion of Senator Johnson, and to obvious leaks of official information to journalists such as the Alsop brothers, to precipitate a public discussion of what has since become known as the "hydrogen bomb," in the American press. Apparently the only people who take secrecy in atomic matters seriously in this country are the much-abused scientists, who, according to Senator Johnson, cannot resist the "yen" to tell everybody all they know about the atom. As soon as a subject gets out of the hands of the scientists (and of the equally maligned Atomic Energy Commission) onto the desks of high military or civilian authorities, or Congressional committees, "top secrets" begin not to leak, but to pour out in torrents.

(We are referring here to loose talk—not to deliberate betrayal of secret information to foreign agents. Treason, as we have unhappily seen lately, is a cancer from which no professional body can consider itself immune.)

THE NATION NOW KNOWS— BUT IT DOES NOT KNOW ENOUGH

The indiscretion of Senator Johnson has had a mixed reception, including praise from the Federation of American Scientists and a reprimand from President Truman. Dr. Bethe, who was the first to interpret the thermo-nuclear origin of the sun's energy, said in an interview that the reasons which induced scientists to impose a four-year-long, voluntary self-censorship on all public discussion of the "super-bomb," are still valid, and that Senator Johnson and the brothers Alsop have damaged American security and the cause of peace by their disclosures.

On the other hand, Dr. Urey, the discoverer of deuterium (without which the thermo-nuclear bomb might have been out of the realm of possibility at the present time) has said that the nation is indebted to Senator Johnson for having broken the conspiracy of official silence on a matter of deep concern to all Americans. In Dr. Urey's opinion—and many will share it—the super-bomb issue needed to be put before the American people. It was bad enough that the decisions first to build and then to use the original atomic bomb had been made by a few persons in high positions and been shrouded in wartime secrecy. The nation as a whole is carrying the burden of responsibility for these steps, and generations to come may have to suffer their consequences. Now, when the question of attempting the construction of a still more devastating weapon is being deliberated in peacetime, Americans must be given the opportunity to decide whether, and under what conditions, they want to embark on this course. Furthermore, only in the light of full knowledge of what a future war may be like, can the American people decide to what lengths they are prepared to go to make our country less vulnerable in war, and how much of our national resources, sovereignty, and living standards they are willing to sacrifice for the sake of making war less likely.

There is little doubt that the Administration is disconcerted by the publicity given the "hydrogen bomb," and would like to see all discussion ended with the President's announcement that he has instructed the Atomic Energy Commission "to continue

vigorous exploration" of all aspects of atomic weapons "including the so-called hydrogen bomb."

Yet, if the disclosure of the super-bomb plans is to serve a better purpose than to provide newspapers with a few scare headlines, and columnists with material for one or two exciting columns; if the compensation for having revealed our concern with thermo-nuclear weapons to a potential enemy is to be the fostering of an informed public opinion, able to comprehend the scope of the decision now being made, and to influence intelligently future decisions concerning the development and use of weapons of mass devastation, public debate must not be squelched at the present time.

This debate has not yet done even remote justice to the grave moral implications of the development to which we are being committed—implications which should affect the conscience of every American (and not only of the scientists who are being asked to carry out the development of the super-bomb). Nor has the public discussion produced as yet sufficient clarity about the technical and military aspects of the building and use of "super-bombs," to permit any but emotional judgments about the inevitability of their development and the existence (or nonexistence) of valid alternatives in the military or political field.

In this issue, the *Bulletin* prints, as its first contribution to this discussion, several reactions by prominent scientists. On the surface, they show a wide difference of attitudes—from Dr. Teller's appeal to physicists to end their "honeymoon with mesons" and go to work on the bomb, to Dr. Einstein's belief in the futility of all armaments. Yet, all these statements have something in common: Even those scientists who consider the exploration of thermo-nuclear bombs an urgent necessity do not think that we can rely on nuclear (or other) weapons alone for the preservation of peace and national security. They, too, call for new and imaginative political action on behalf of world unity and peace, and see in a superior weapon development, at best, a means to gain time and put additional force behind this action.

In its future issues, the *Bulletin* will provide deeper and more detailed analysis of the moral, political, and military implications of the development of thermo-nuclear weapons than has been possible in these first reactions.

Dr. Klaus Fuchs to Stand Trial for Espionage

On February 8, Dr. Klaus Fuchs, formerly group leader at the Los Alamos atomic bomb laboratory, and lately head of the theoretical physics division at the main British atomic energy establishment at Harwell, was brought before the court in London. The Crown testified that he has signed a statement admitting having repeatedly passed secret information to Soviet agents since 1942. The court ordered him to stand trial on charges of violation of the Official Secrets Act.

The United States Atomic Energy Commission has released the following statement on Dr. Klaus Fuchs.

"Dr. Klaus Fuchs was a member of the British atomic energy mission sent to this country during the war. He was engaged in project work from December 1943 until June 1946. He was first engaged in the early work done on the gaseous diffusion process in New York City. In December 1944 he went to Los Alamos with the British scientific team assigned to weapons work and in this position had access to a wide area of the most vital weapons information. Dr. Fuchs returned to England in June 1946, and has not been employed in the U.S. atomic energy project since that time.

"In November 1947 he visited the United States as a member of the British delegation to participate in discussions on the use of the Declassification Guide, which had been developed during 1945 and 1946 and has been used by Canada and the United Kingdom since April 1946. The Declassification Conference, announced November 14, 1947, was limited to fields of information shared by the three countries, as a result of their combined wartime efforts in the development of atomic energy. The conference was arranged to insure uniform application of declassification policy by the three governments.

"In addition to the Declassification Conference in Washington, Dr. Fuchs was permitted to visit the Argonne National Laboratory at Chicago for discussions limited to non-secret scientific material."

The American public has been so accustomed to sensationalized revelations of "atomic espionage" by the Hearst press and the Committee on Un-American Activities, that it might have difficulty in appreciating the grim seriousness of the case of Dr. Fuchs. Perhaps the most important aspect of his treasonable activities is that he has been associated with the atomic energy project since its very inception and must have alerted the Soviet leaders to the approaching achievement long before the Potsdam Conference and the Hiroshima explosion. If his information was heeded, the Soviet development of the atomic bomb could have begun two or three years earlier than is generally assumed. The basic scientific data of the bomb, supplied by him at the time of their first determination, might have saved the Soviet scientists additional months of their own research and development.

The American scientists can derive no satisfaction from the fact that so far, at least, the only two cases among the thousands of scientists who have worked on the atomic energy project, in which the oath of secrecy was broken in the interest of a foreign power, have occurred in the British contingent. No large body of professional workers can be safe from the presence of a few venal or subverted individuals, and atomic scientists are probably the most sought-after secret agents in the world at the present time.

The unmasking of an outstanding atomic scientist as a Soviet agent is likely to prove as profitable, from the Soviet point of view, as the presence of such an agent in the very nerve center of the atomic energy project might have been in the past.

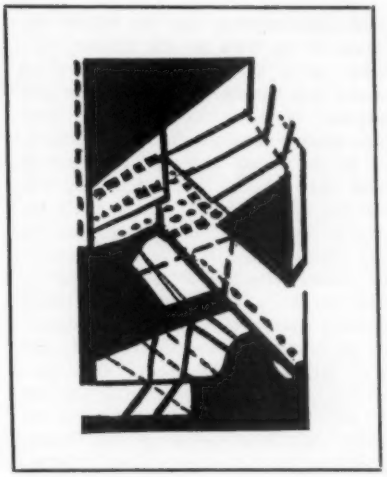
This revelation will strengthen the smug belief in American scientific and technological superiority ("now we know how the Russians were able to explode an atomic bomb—they just stole it from us"); and it will add weight to the counsels of the worst enemies of American atomic energy progress—politicians and commentators who never could have enough secrecy, compartmentalization, and isolation from the rest of the scientific world, in the American atomic energy laboratories.

Even at this unpropitious juncture, it must be repeated that the main reason for the Soviet success in producing the atomic bomb was *not* espionage, but possession by the Soviet Union of enough scientific and engineering brain power, and of enough industrial resources and know-how, to make full

(Continued on page 94)

THE SUPER BOMB

Hans Thirring



The following description of the theory of the thermo-nuclear bomb was written by a distinguished Austrian physicist and published in Vienna in 1946, as a chapter of his book on the atomic bomb. The book, "Die Geschichte der Atombombe," was reviewed in the "Bulletin" in April 1948.

IT IS natural to think of the possibility of using fissionable materials, such as U-235 or plutonium, which are difficult to prepare and will never be available in large quantities, as detonators to start other nuclear processes in more abundant materials.

Ever since Cockcroft and Walton succeeded in producing nuclear transformations by fast ions, scientists have been measuring minimum energies required to initiate various nuclear processes. In the earliest experiments on the disintegration of nuclei, the ammunition used were alpha particles with an energy of several million electron volts. Experiments with electrical atom-smashing machines, first employed by Cockcroft and Walton, have revealed that protons with an energy of only a few hundred thousand electron volts were sufficient to initiate certain nuclear processes. Furthermore, it is clear that the initiation of nuclear processes by collisions depends only on the mass and energy of the colliding particles, and not on the way in which the energy was communicated to them. If, therefore, it should be possible to create somewhere in a mass of matter, a temperature high enough for the thermal energy of the atoms to become equal to, or greater than, the energy required for the initiation of a certain nuclear process, it must be possible, at least in principle, to initiate this process in a purely thermal manner, by a kind of "ignition" mechanism.

If, furthermore, the process, started in this way, should proceed so fast and develop so much energy that the temperature should continue to rise, a thermal "chain reaction" would become possible, with the nuclear transformation spreading like an explosion over the whole available amount of the material.

The difficulty of this idea, which appears so simple, lies in the fact that all temperatures that could be reached under the previously available terrestial conditions were many orders of magnitude smaller than the lowest known threshold of energy required for initiation of a nuclear reaction. In order to raise the average kinetic energy of a gas molecule to a value as low as one electron volt, it would be necessary to heat the gas to a temperature as high as 7,700 degrees on the absolute scale, a temperature higher than that of the surface of the sun. An average energy of one million electron volts could be reached only at a temperature of 7.7 billion degrees!

Before the discovery of nuclear fission and of the nuclear chain reaction, no one could envisage the possibility of creating such temperatures. A detonating atomic bomb creates however, extreme conditions. In the moment of the explosion, billions and billions of atoms of fission products are created, which fly apart with energies of the order of 100 million electron volts. If these fission nuclei strike other atomic nuclei on their path—for example, the nuclei of a tamper material—they might be able to enter into nuclear reaction with them, or to transfer so much energy to the collision partners that these themselves become projectiles of high energy, able, in their turn, to produce nuclear reactions. Let us consider a concrete example:

PRINCIPLE OF THE DD REACTION

We assume that the detonator is plutonium in an atomic bomb, and that it is surrounded by a substance which contains deuterium, such as heavy water or heavy paraffin. Outside this first sheath we can imagine the presence of a second one, made of heavy material which acts as a tamper to prevent the bomb from flying apart too soon. In the moment of explosion the plutonium will emit fission products with energies of the order of 100 million electron volts. These will undergo collisions with the deuterons in heavy water and transmit part of their energy to the latter. The energy acquired in this way by the deuterons is, it is true, only a small fraction (not more than 4 per cent) of the energy of the original fission products. Nevertheless, this energy may be high enough to permit the accelerated deuteron to undergo a so-called "*dd*-reaction" with another deuteron, which it might encounter on its path. This reaction will convert two deuterons, each with mass 2 and atomic number 1, into a helium isotope (helium 3) with mass 3 and atomic number 2, and a neutron with mass 1 and atomic number 0. Measurements made in America have established that for this reaction to occur, the collision energy need not be higher than 1/10 mega electron volt (one megavolt is a million volt). The energy released in this reaction, which must appear as the kinetic energy of the two prod-

Hans Thirring, *Die Geschichte der Atombombe* (Vienna: Neues Osterreich Zeitungs-und-Verlagsgesellschaft, 1946), Chapter 42. Used by permission of the Publisher.

ucts—the neutron and the helium nucleus—is as high as 3.3 million electron volts. It is true that the fact alone that the energy liberated in this process is considerably higher than the energy required for its initiation, is by no means sufficient to conclude that this process, once initiated, will develop spontaneously into a chain reaction. The fast neutron formed in the *dd*-reaction will have to hit another deuteron under a specially favorable angle to transmit to the latter enough energy to allow it to undergo, in its turn, a *dd*-reaction by collision with still another deuteron, thus continuing the chain. Considering the low probability of nuclear hits, it is obvious that a sequence of two favorable hits will be very unlikely. Therefore, at all temperatures of less than several million degrees, a reaction of the considered type will practically never repeat itself in a chain. In other words, no *dd*-chain reaction is possible under presently known conditions, and this is good because otherwise our earth would probably long ago have vanished in a cloud of incandescent dust, to appear as a new star in the sky.

THEORY OF THE PLUTONIUM-DEUTERON BOMB

The *dd*-reaction will thus never develop on a large scale as the consequence of a single initial process, as is the case in the fission of U-235 or plutonium. However, if heavy water is placed in direct contact with detonating plutonium, what will occur, is not a single elementary reaction, but a simultaneous impact on deuterium atoms of billions of high-energy fission products, creating such enormous temperatures that a considerable fraction of deuterons will acquire the energy sufficient to undergo a *dd*-reaction. The occurrence of a large number of these secondary reactions will cause a further increase in temperature, and it is not altogether impossible, that a chain reaction will maintain itself through a purely thermal mechanism despite the enormously high temperature required. Under the pressures and temperatures existing in the interior of stars, thermal nuclear reactions are actually known to occur. It is, however, open to grave doubts whether, by the use of an amount of tamper material which will keep the bomb within reasonable dimensions, the plutonium-deuteron bomb could be prevented from flying apart much too fast to maintain the temperature required for the continuation of the thermal chain reaction. For this reason, the possibility of producing chain reactions of light elements is still open to grave question.

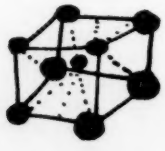


TABLE 1

APPROXIMATE CALCULATION OF THE ENERGY WHICH CAN BE OBTAINED THROUGH NUCLEAR TRANSFORMATION OF 1 KILOGRAM

Substance	U-235	D_2O	LiH
Process	Fission	$^{2}_{1}H(d,n)^{3}_{2}He$	$^{7}_{3}Li(p,\alpha)^{4}_{2}He$
Energy per single atom	200 MeV	3.3 MeV	17.3 MeV
Atomic weight	235	$2\times2+16=20$	$7+1=8$
No. of atoms in 1 kilogram	$\frac{1,000}{235\times1.67\times10^{-24}}=$ $=2.55\times10^{24}$	$\frac{1,000}{20\times1.67\times10^{-24}}=$ $=30\times10^{24}$	$\frac{1,000}{8\times1.67\times10^{-24}}=$ $=75\times10^{24}$
Energy per 1 kilogram	$2.55\times10^{24}\times200$ MeV = $=5.1\times10^{26}$ MeV = $=5.1\times10^{26}\times1.6\times10^{-6}=$ $=8.16\times10^{20}$ erg $=8.16\times10^{20}\times2.39\times10^{-11}=$ $=1.95\times10^{10}$ kcal $=1.95\times10^{10}/860=$ $=22,700,000$ kWh	$3\times10^{24}\times3.3$ MeV $=10^{25}$ MeV $=1.6\times10^{19}$ erg $=0.38\times10^{10}$ kcal $=4,400,000$ kWh	$7.5\times10^{24}\times17.3$ MeV = $=1.3\times10^{27}$ MeV. $=21\times10^{20}$ erg $=5\times10^{10}$ kcal $=58,000,000$ kWh

1 MeV = 1.6×10^{-6} erg 1 erg = 2.39×10^{-11} kcal 1 kcal = 1/860 kWh

THE LITHIUM HYDRIDE BOMB

Another substance which perhaps could be brought to chain reaction by the detonating action of an atomic bomb, is a mixture containing lithium and hydrogen, for example, the compound lithium hydride. At a temperature of several million degrees, the lithium nuclei (mass 7, atomic number 3) can react with hydrogen nuclei (mass 1, atomic number 1) forming two nuclei of ordinary helium (mass 4, atomic number 2). The impact of a high energy proton on a lithium nucleus will produce an intermediate nucleus of mass 8 and charge 4, which will fission into two alpha particles (helium nuclei) of very high energy. American measurements have shown that here, too, the initiation of the nuclear reaction is possible with energies of less than 1/10 mega electron-volt, while the energy liberated in the reaction has the remarkably high value, for such light nuclei, of 17.3 million electron volts!

Table 1 shows the calculation of the total energy which will be liberated by complete fission of one kilogram of U-235, compared to the energy liberated from an equal mass of deuterium undergoing a *dd*-process, and an equal mass of lithium and hydrogen undergoing transformation into helium.

As one can see from the table, one kilogram of lithium and hydrogen will produce almost three times as much energy as an equal mass of U-235! Remember that lithium is not a rare element, and that one could easily obtain as many *tons* of it, for use in a super-bomb, as are now available *kilograms* of plutonium for use in "ordinary" atomic bombs! The total energy of available nuclear explosives could thus be increased several thousand times compared to the energy that now can be stored in the form of plutonium and U-235 alone. God protect the country over which a sixton bomb of lithium hydride will ever explode!

If this idea is at all capable of realization, it is obvious that a uranium 235, or a plutonium bomb of the present type will have to serve as a detonator in the new super-bomb. In contrast to the conventional detonator used to explode shells, this detonator cannot be made as small as may be desirable, because it has to fulfil the critical size condition required for the development of a fission chain reaction. Thus, if the rare materials, U-235 or plutonium are used successfully as detonating caps for super-bombs, it would not be possible to make thousands of such bombs from a single kilogram of fissionable materials. The "progress" achieved by the realization of the super-bomb (if you can call it progress) will therefore consist in considerable increase in the *power* of each single atomic bomb, not in a substantial increase of their *number*.

WHAT THE SCIENTISTS ARE SAYING

Arms Can Bring No Security

Albert Einstein

THE idea of achieving security through national armament is, at the present state of military technique, a disastrous illusion. On the part of the United States this illusion has been particularly fostered by the fact that this country succeeded first in producing an atomic bomb. The belief seemed to prevail that in the end it were possible to achieve decisive military superiority.

In this way, any potential opponent would be intimidated, and security, so ardently desired by all of us, would be brought to us and all of humanity. The maxim which we have been following during these last five years has been, in short: security through superior military power, whatever the cost.

This mechanistic, technical-military, psychological attitude had inevitable consequences. Every single act in foreign policy is governed exclusively by one viewpoint.

How do we have to act in order to achieve utmost superiority over the opponent in case of war? Establishing military bases at all possible strategically important points on the globe. Arming and economic strengthening of potential allies.

Within the country—concentration of tremendous financial power in the hands of the military, militarization of the youth, close supervision of the loyalty of the citizens, in particular, of the civil servants by a police force growing more conspicuous every day. Intimidation of people of independent political thinking. Indoctrination of the public by radio, press, school. Growing restriction of the range of public information under the pressure of military secrecy.

The armanent race between the USA and the USSR, originally supposed to be a preventive measure, assumes hysterical character. On both sides, the means to mass destruction are perfected with feverish haste—behind the respective walls of secrecy. The H-bomb appears on the public horizon as a probably attainable goal. Its accelerated development has been solemnly proclaimed by the President.

If successful, radioactive poisoning of the atmosphere, and hence annihilation of any life on earth, has been brought within the range of technical possibilities. The ghostlike character of this development lies in its apparently compulsory trend. Every step appears as the unavoidable consequence of the preceding one. In the end there beckons more and more clearly general annihilation.

Is there any way out of this impasse created by man himself? All of us, and particularly those who are responsible for the attitudes of the U. S. and the USSR, should realize that we may have vanquished an external enemy, but have been incapable of getting rid of the mentality created by the war.

It is impossible to achieve peace as long as every single action is taken with a possible future conflict in view. The leading point of view of all political action should therefore be: What can we do to bring about a peaceful co-existence and even loyal cooperation of the nations?

The first problem is to do away with mutual fear and distrust. Solemn renunciation of violence (not only with respect to means of mass destruction) is undoubtedly necessary.

Such renunciation, however, can only be effective if at the same time a supra-national judicial and executive body is set up empowered to decide questions of immediate concern to the security of the nations. Even a declaration of the nations to collaborate loyally in the realization of such a "restricted world government" would considerably reduce the imminent danger of war.

In the last analysis, every kind of peaceful cooperation among men is primarily based on mutual trust and only secondly on institutions such as courts of justice and police. This holds for nations as well as for individuals. And the basis of trust is loyal give and take.

What about international control? Well, it may be of secondary use as a police measure. But it may be wise not to overestimate its importance. The times of prohibition come to mind and give one pause.

Back to the Laboratories

Edward Teller

PRESIDENT TRUMAN has announced that we are going to make a hydrogen bomb. No one connected with work on atomic bombs can escape a feeling of grave responsibility. No one will be glad to discover more fuel with which a coming conflagration may be fed. But scientists must find a modest way of looking into an uncertain future. The scientist is not responsible for the laws of nature. It is his job to find out how these laws operate. It is the scientist's job to find the ways in which these laws can serve the human will. However, it is *not* the scientist's job to determine whether a hydrogen bomb should be constructed, whether it should be used, or how it should be used. This responsibility rests with the American people and with their chosen representatives.

Personally, as a citizen, I do not know in what other way President Truman could have acted. As a scientist, I am troubled by other questions, more limited, more specific, but not less urgent and not less harrassing. Can

a hydrogen bomb be built? How can we build it? Can we build it before the Russians succeed in doing so?

I cannot answer these questions. Even the elements which will be used in answering them cannot be mentioned publicly. But the background from which we start in our work can be discussed, and this discussion may be found relevant.

The situation should be similar to the one in 1939. I am sure that all of us remember it well. A conference comes to my mind. The scientists present were urging that work on atomic bombs should be started. We said that such bombs could probably be made. We said that the fate of the war, which had started with the crushing defeat of Poland, might hinge on atomic energy.

The colonel, who was listening to us was not interested. He had heard too much of secret weapons. He told us about a goat which he had tethered for experimental purposes on his test site. He had offered a prize to any inventor of a new weapon which could kill the goat from ten paces. (I think he had death-rays in mind—apparently the thing closest to atom bombs in his way of thinking.) The goat was still thriving. "Moreover," the colonel went on, "wars are not won by weapons. They are won by the justice of the cause."

Tempora mutantur. I have not met any skeptic like that colonel in army uniform in a long time. Today there is a discussion of the possibility of a new weapon; already it is considered a reality.

On the other hand, many of the scientists now think, "Peace is not won by weapons." Ghost of the colonel!

To my mind we are in a situation not less dangerous than the one we were facing in 1939, and it is of the greatest importance that we realize it. We must realize that mere plans are not yet bombs, and we must realize that democracy will not be saved by ideals alone.

Our scientific community has been out on a honeymoon with mesons. The holiday is over. Hydrogen bombs will not produce themselves. Neither will rockets nor radar. If we want to live on the technological capital of the last war, we shall come out second best. This does not mean that we should neglect research or teaching. If we get to work now, it will be sufficient to have perhaps one quarter of the scientists engaged on war work. The load could be lightened by rotation. If we wait too long, not even the effort of all the scientists will suffice.

Do we dare to hope that all citizens in their turn will realize: democracy will not be saved without some daring ideals? I do not believe that the hydrogen bomb or the whole arsenal of technological warfare will save the United States unless we accept the fact that the United States and all the freedom-loving people of the whole world must be saved. The grim alternative is that all of us will live under tyranny.

Many of our friends are disheartened. They had some hope in the summer of 1945. But if the atom bomb did not help to establish peace, why should the hydrogen bomb? Why should anything else, for that matter? I think we should try again. The situation is now different. We have now a success and a failure behind us: The scientists enjoy the prestige of having successfully made atomic weapons; their advice may have a somewhat greater weight now. We also have had the experience of a dismal failure: We did not have enough realism, courage, and initiative at the time of Hiroshima. We did not, in fact, win the peace. We must try again; there is no other way. Such a new attempt cannot come from the scientist, however strongly he feels about the subject. The primary responsibility for action lies with the groups directing the policy and foreign relations of our country.

To the scientist, at least, it should be clear that he can make a contribution by making the country strong. And he can continue to make a contribution by explaining this dangerous world to his fellow-citizens.

Should America Build the H-Bomb?

Harold C. Urey

RECENTLY a very great service has been done for the people of the United States by Senator Johnson. Quite unwittingly, he has brought to the attention of the people of the United States a problem which should have been considered by them a very long time ago, if adequate discussion had not been prevented by the neurotic fears of U.S. officials. I refer to the momentous decisions which have to be taken in relation to the so-called hydrogen bomb. It is true that most of the pertinent facts have made their way into the press, but so long as the Government refused to take the American people into its confidence, the whole subject was bound to be invested with the kind of mystery and misinformation which once surrounded the atomic bomb. The early decisions regarding the hydrogen bomb have been taken in a quite incredible manner. According to the Alsop brothers, this problem was considered in 1945 by President Truman, and on the advice of two prominent scientists, it was decided that no development of this weapon should be made. I was not aware that such a decision had been made, and I think few people in the United States were aware of it. The men who, according to the Alsop brothers, have advised that we should not develop the hydrogen bomb, were those who believed that it would take the USSR ten or fifteen years to produce the "ordinary" atomic bomb!

The question before us is this: Should the hydrogen bomb be built? First of all, it has been publicly reported for several years that such bombs would have a capacity of the order of one thousand times the capacity of the atomic bomb which has been developed in the past. It has been reported that if a large enough number of such bombs were dropped off the Pacific Coast of the United States, the prevailing winds would carry the radioactivity over this country and would result in the extinction of all forms of life. I cannot vouch for the accuracy of this statement, but the effects of the radioactivity would certainly be far greater than those so dramatically exhibited at the Bikini Baker Day bomb test. It is unnecessary to emphasize the unpleasantness of such weapons. Many would wish that such weapon developments as these should prove physically impossible; but nature does not always behave in the way we desire. I believe we should assume that the bomb *can* be built.

The Alsop brothers say that the cost of the development of these bombs would be two to four billion dollars. This I doubt seriously. I am not connected with this project in any way, but it is difficult to see how the develop-

ment itself should cost more than a hundred million dollars, exclusive of the cost of materials. It would, of course, involve a considerable scientific and engineering talent, which I would much prefer to see employed on peacetime developments.

But let us turn to the situation in the world today. We should not be complacent about the inability of other countries to develop this weapon, as many people were in connection with the development of the ordinary atomic bomb. To be specific, let us assume that the USSR is developing this bomb; and suppose that she should perfect it first. Then it seems to me that there is nothing in the temperament of the present negotiations between East and West that would lead us to believe that the rulers of the USSR would not reason approximately as follows:

"It is true that the bomb is exceedingly dangerous, and we would not wish to produce so much radioactivity in the world as to endanger ourselves and the people of Russia, but the explosion of a few of these bombs will win us the world. Therefore, we will build these bombs and issue ultimata to the Western countries, and the millenium of communism will be with us immediately. After this the universal government of the USSR will abolish all stocks of bombs, and no more will ever be made in the world."

This is a very good argument. In fact, I doubt if any bombs would need to be exploded. The atomic bomb is a very important weapon of war, but hardly decisive, as everyone has emphasized from the beginning. But I wonder if the hydrogen bomb would not be decisive, so that ultimata would be accepted and it would be unnecessary to deliver the bombs.

Confronted by this possibility, what should the United States do now? Judging from our past decisions, we have apparently decided to lose the armaments race. Suppose instead of deciding this, we decide we will build the hydrogen bomb. And suppose we get it first. What then? It is quite out of character for the democracies to behave as I have suggested that the USSR would behave. Would we wait until the USSR had it, too? In that event, how could we be sure that war would not result from some inflammable incident, or from a calculation that a minor disturbance in a delicate balance of power had brought one of the powers a decisive advantage?

Suppose that two countries have the hydrogen bomb. Is it not believable that sooner or later an incident may occur which would precipitate the use of bombs? This is a question again which I cannot answer definitely. I would say, however, that the probability that a war will start is increased if two groups each believe that they can win that war. This is true regardless of weapons and their magnitude. An exact balance of power is very difficult to attain. This is what we know in physical science as a situation of unstable equilibrium; one like balancing an egg on its end. The slightest push topples the egg in one direction or another.

I have maintained, and many of my friends have maintained, the only constructive way to solve the present problem is by adopting the Atlantic Union Resolution now in the Senate and House of the Congress of the United States, which would instruct our government to work toward the creation of a Federal Union of the democratic countries. Only in this way will the Western democratic powers be able to maintain an overpowering political, commercial, military, and ideological strength. Only in this way can we have an enormous unbalance of power, so that perhaps one side does not attempt to start a war because it recognizes that it cannot win, and the other side does not need to start a war because it knows that the weaker side will not dare to attack. If this organization were perfected in the next few years there would be no question about the strength of the West, and this, regardless of the existence of any type of bombs in the world, might lead to a peaceful solution of the problem.

I am very unhappy to conclude that the hydrogen bomb should be developed and built. I do not think we should intentionally lose the armaments race; to do this will be to lose our liberties, and, with Patrick Henry, I value my liberties more than I do my life. It is important that the spirit of independence and liberty should continue to exist in the world. It is much more important that this spirit continue to exist than that I or you or any group should continue this mortal existence for a few years more. Second, there is no constructive solution to the world's problems except eventually a world government capable of establishing law over the entire surface of the earth. It is necessary to take whatever steps we possibly can in that direction, and to take them as rapidly as possible. This, to me, includes *any* step that moves us in the desired direction, including the strengthening of the United Nations, and of all of the international organizations sponsored by the UN, the establishment of an Atlantic Union of the democratic countries of the world, which understand each other from the standpoint of political institutions, general philosophy of life, and religion; and the extension of any such organization to as much of the rest of the world as possible, and in as short a time as possible. May I emphasize; this is the only constructive direction in which to work.

I repeat that I am much indebted to Senator Johnson for having lifted the veils of secrecy which have obscured this situation, so that we can discuss it intelligently. Now, if he or someone else will only do the same thing for peacetime uses of atomic energy I shall be very grateful indeed. In fact, if we would only forget secrecy and regard it as the wholly unimportant subject that it is, progress in all lines of scientific activity of benefit to the United States and to the world would be enormously increased.

Break the Deadlock!

Federation of American Scientists

THE atomic armament race has entered a new phase with President Truman's "go ahead" signal for development of the hydrogen bomb. In this new phase two things should be clear to the American people: (1) We can be sure that if we build H-bombs, the Russians will build them also; we must have no illusions of security based on monopoly of a super-weapon. (2) The kind of security we want can be had only by building a stable peace. We know that no weapon, however powerful, can give security to any nation; no defense will bring freedom from fear.

No nation is secure against the hydrogen bomb. Of all the cities in the world, not one is safe. Of all the cities in the world, not one presents a better target than New York. Superficially, the super-bomb appears to threaten our rival, but the President and the people must see that the threat lies nowhere sharper than here, in our homes, in our cities. American scientists are of many minds on many issues, but on one we unite: our country must turn from the false security of bombs to the slow, difficult task of gaining security by a positive approach to peace through mutual agreement, to peace by gradual disarmament, to peace by world-wide economic reconstruction and development.

The policy of our country has faced in two directions. We have sought to achieve international control of atomic energy on one hand, while, on the other, basing our military planning on atomic armaments. The question which faces us today is whether the United States will persist in its avowed policy of seeking peace through agreement or whether it will pay lip service to this policy while relying on force.

The decision on the hydrogen bomb can be interpreted by the world as a symbol that we have now set our course. We have placed a terrible weight in the balance for destruction. A greater weight must be placed on the side of real security and peace. Already a few voices have solemnly and wisely urged such a course. We repeat now our request that the President establish without delay a new commission, with the broad perspective of the Acheson-Lilienthal Commission of 1946, to examine the whole issue of our atomic policy and to make a fresh start, looking toward a policy which offers some real hope of breaking the present stubborn deadlock.

The United States has sought atomic agreement separate from other related issues. It seems necessary now to seek a solution within a much broader framework. Our objective must continue to be effective atomic control, including thorough-going inspection. But we must consider alternative proposals; perhaps proposals without the far-reaching international ownership concept, perhaps proposals making greater concessions to national interests, certainly proposals in which procedural issues are subordinate to the simple question of adequacy in giving nations warning of possible violation.

We call upon Americans to see in the President's announcement a new warning and a new challenge. We still have hope that there are no differences so great that they can be solved only by atomic war.

Let the People Decide!

Arthur H. Compton

The following statement by Dr. A. H. Compton, Chancellor of Washington University and noted physicist, was made on January 29, 1950—three days before the President's announcement.

THE question is: Should the U. S. attempt to develop such more destructive, perhaps vastly more destructive, weapons?

My reply is that in a democracy the ultimate answer to such a question rests with the people, just as does the right to declare war.

Those who must take action are those entrusted with the defense of the nation, the Commander-in-Chief, i.e., the President, the Department of Defense which reports to him, and Congress. As sound military strategy, it is probable that the American course of action on such a matter as this should not be made known unless as a part of a general international agreement; for such knowledge would aid our potential enemies. But the decisions made by the President and his advisors should be based on a knowledge of the views of the American people, to whom they are ultimately responsible.

Thus, the moral and practical question, "Should we try to develop a weapon that might be 1,000 times more destructive than the A-Bomb," should be referred to the people for their judgment. This judgment must be weighed by the President in light of his knowledge of the military situation as he instructs the Department of Defense what course of action to follow.

The factors that must be considered are such as these:

1. Will the new weapon be an important help in defense in case of war?

2. Will its development be a deterrent to war? In the answer to this we must consider both an enemy's fear lest a war bring upon him the destruction that the new weapon can cause, and also the result of a determined armament race that may be stimulated by knowledge or suspicion that it is being developed in our country.

3. Are we willing to take the human responsibility for preparing such a deadly and destructive weapon, knowing that its preparation will probably lead to its use if a serious war comes?

4. Are we willing to take the responsibility for *not* preparing such a weapon for our defense, when we know that if we can make it, other nations can also, and that very possibly it is already under active development elsewhere?

It is yet to be demonstrated, I believe, that the development of more destructive weapons has led to greater proportional loss of life among warring nations. Thus, the wars fought by the Roman sword and by the mounted archers of Ghengis Khan remain symbols of total destruction. On the other hand, the weight of evidence indicates that the introduction of the A-Bomb reduced the number of lives required to bring World War II to a conclusion.

Would not the refusal to develop such weapons of greater destruction in the

absence of any reliable international agreement mean resigning ourselves to surrender to the superior force of our rivals whenever such force is pressed upon us? Would this mean failure to do our share in protecting other nations which perforce look to us in aiding their defense?

My main point is that this is not a question for experts, either militarists or scientists. All they can do is to explain what the results will be if we do or do not try to develop such destructive weapons. The American people must themselves say whether they want to defend themselves with such weapons or whether they prefer to take what others may force upon them rather than resort to the destructive action which such weapons make possible.

The familiar techniques of the opinion polls, when applied in the effort to get a fair sampling of views, may be adequate to find what we Americans think. It is possible that the result will be overwhelmingly in favor of developing the H-Bomb in case the President's military advisors are agreed that its development will strengthen our defense more than will an equal effort spent along some other line.

If this is the dominant American view, I think it ought to be known. Expressions to this effect would greatly strengthen the morale of the scientists and others whose task it would be to proceed with making the new weapons.

Fateful Decision

J. Robert Oppenheimer

THE decision to seek or not to seek international control of the A-bomb, the decision to try to make or not to make the H-bomb, are issues, rooted in complex technical matters, that nevertheless touch the very basis of our morality. There is grave danger for us in that these decisions have been taken on the basis of facts held secret. This is not because the men who must contribute to the decisions, or must make them, are lacking in wisdom; it is because wisdom itself cannot flourish, nor even truth be determined, without the give and take of debate or criticism. The relevant facts could be of little help to an enemy; yet they are indispensable for an understanding of questions of policy. If we are wholly guided by fear, we shall fail in this time of crisis. The answer to fear cannot always lie in the dissipation of the causes of fear; sometimes it lies in courage.

Response made in the course of Mrs. Roosevelt's Round Table broadcast of February 12th.

Let Us Pledge Not to Use H-Bomb First!

At the close of the recent meeting of the Physical Society in New York, twelve of the country's prominent physicists issued the following statement:

A FEW days ago, President Truman decided that this country should go ahead with the construction of a hydrogen bomb.

This decision was one of the utmost gravity. Few of the men who publicly urged the President to make this decision can have realized its full import. Among the reports in the press was a great deal of misinformation. However, it was stated correctly that a hydrogen bomb, if it can be made, would be capable of developing a power 1,000 times greater than the present atomic bomb. New York, or any other of the greatest cities of the world, could be destroyed by a single hydrogen bomb.

We believe that no nation has the right to use such a bomb, no matter how righteous its cause. This bomb is no longer a weapon of war but a means of extermination of whole populations. Its use would be a betrayal of all standards of morality and of Christian civilization itself.

Senator McMahon, in a speech on Thursday, February 2, has pointed out to the American people that the possession of the hydrogen bomb will not give positive security to this country. We shall not have a monopoly of this bomb, but it is certain that the Russians will be able to make one too. In the case of the fission bomb the Russians required four years to parallel our development. In the case of the hydrogen bomb they will probably need a shorter time. We must remember that we do not possess the bomb but are only developing it, and Russia has received, through indiscretion, the most valuable hint that our experts believe its development possible. Perhaps the development of the hydrogen bomb has already been under way in Russia for some time. But if it was not, our decision to develop it must have started the Russians on the same program. If they had already a going program, they will redouble their efforts.

Statements in the press have given the power of the H-bomb as between 2 and 1,000 times that of the present fission bomb. Actually the thermonuclear reaction, on which the H-bomb is based, is limited in its power only by the amount of hydrogen which can be carried in the bomb. Even if the power were limited to 1,000 times that of a present atomic bomb, the step from an A-bomb to an H-bomb would be as great as that from an ordinary TNT bomb to the atom bomb.

To create such an ever-present peril for all the nations in the world is against the vital interests of both Russia and the United States. Three prominent senators have called for renewed efforts to eliminate this weapon, and other weapons of mass destruction, from the arsenals of all nations. Such efforts should be made, and made in all sincerity by both sides.

In the meantime, we urge that the United States, through its elected government, make a solemn declaration that we shall never use this bomb first. The circumstance which might force us to use it would be if we or our allies were attacked by *this* bomb. There can be only one justification for our development of the hydrogen bomb, and that is to prevent its use.

—Signed

S. K. ALLISON, Director of Institute for Nuclear Studies, University of Chicago

K. T. BAINBRIDGE, Harvard University

H. S. BETHE, Cornell University

R. B. BRODE, University of California

C. C. LAURITSEN, Director of Kellogg Radiation Laboratory, California Institute of Technology

F. W. LOOMIS, Chairman of Physics Department, University of Illinois

G. B. PEGRAM, Dean of Graduate Faculties, Columbia University

B. ROSSI, Massachusetts Institute of Technology

F. SEITZ, University of Illinois

M. A. TUVE, Director, Department of Terrestrial Magnetism, Carnegie Institution, Washington, D.C.

V. F. WEISSKOPF, Massachusetts Institute of Technology

M. G. WHITE, Princeton University

THE H-BOMB AND AFTER

Hans J. Morgenthau

In the January issue of the "Bulletin" Hans J. Morgenthau, Professor of Political Science at the University of Chicago, proposed settlement of our conflict with Russia over control of Eastern Europe as the first objective of American foreign policy. Here he reaffirms his point and warns against considering disarmament a substitute for solving the basic political differences of the two nations.

THE public discussion of the H-bomb has centered around three problems: its technological feasibility and advisability, its moral justification, its politico-military neutralization by way of disarmament.

On the first issue the layman has very little to say. He may ask a few questons. He can ask whether the attempt to build an H-bomb is likely to succeed; whether we have the resources to combine the production of H-bombs with the preparation of atomic defenses; whether a comparison of this weapon's usefulness with other available instruments of war justifies the commitment of the resources necessary for the production of H-bombs; whether, in particular, the character of the probable targets against which the H-bomb might be used makes it the most effective available weapon; whether the psychological effects upon friend and foe alike of the decision to produce it, and the political developments therefrom might not outweigh the direct military advantage. It is one of the peculiarities of the technological character of modern war that the layman may at best be able to formulate a few relevant questions, but that he is unable to answer them. It is for the technological experts to answer them, and the layman must accept the answers.

The question of the moral justification cannot fail to be answered in the affirmative. The moral dilemma with which the H-bomb confronts the United States is different only in magnitude, but not in kind, from the dilemmas with which all the modern instruments of mass destruction, from the machine gun onwards, have confronted the conscience of the Western world. The problem is insoluble on the technological level. For, short of a universal moratorium on scientific progress, there is no way of preventing the inner logic of scientific development from presenting us with ever greater opportunities for either betterment or destruction. Nor is the problem soluble on the level of pure morality. On all levels of technology the means of retaliation are bound to be commensurate with the means of attack. Hence, the modern state can no more afford to be without all the weapons which modern technology puts at its disposal than could the medieval knight afford to be without a sword since his potential adversary was thus armed. On June 11, 1938, Secretary of State Hull declared with reference to the aerial bombardment of Canton by Japan that the Administration disapproved of the sale of aircraft and aircraft armaments to countries which engaged in the bombing of civilian populations; on December 2, 1939, President Roosevelt declared a similar moral embargo against the Soviet Union in view of the bombing of Finnish civilians. A few years later the ruins of bombed cities on either side of the battle lines gave eloquent testimony to the impotence of moral scruples in the face of generally available and generally recognized technological opportunities.

THE NEW CALL FOR ATOMIC DISARMAMENT

It is this awareness of the ineluctable ascendancy of technology over morality in times of war which, ever since Hiroshima, has given rise to the cry for international control of atomic energy, that is, atomic disarmament. Thus, once the inevitability of the H-bomb was conceded, the virtually unanimous reaction of public opinion was: let us have another try at international control. Let us atone, as it were, for our atomic sins, past and future, by trying to devise a mechanism which will restrain us who are unable to restrain ourselves. Even if we should continue to fail in our endeavors—and there is little real expectation that atomic disarmament can succeed under present conditions—we shall then have at least the moral satisfaction of having done everything humanly possible to stave off the calamity of a war fought with H-bombs. Undismayed by almost uniform failure, the Western world has, since the end of the Napoleonic Wars, been fascinated by the hope that the threat of war can be met by disarmament. It remains only consistent, while dooming itself to renewed failure, when it seems to be able to think of only one answer to the threat of the H-bomb: disarmament.

DISARMAMENT A BY-PRODUCT OF POLITICAL SETTLEMENT

Yet while one must sympathize with the psychological compulsion to break out of the vicious circle of the armaments race, one cannot but recognize the grievous error in the means employed and the objectives sought. First of all, even if atomic disarmament were possible, it would not mean peace, but only the elimination of certain types of weapons. Second, and most important, disarmament can succeed only as the by-product of a political settlement, not as a substitute for it. Both historic experience and political analysis bear out these propositions.

The advocates of disarmament start with the assumption that men fight because they have arms. It follows from this assumption that men would stop fighting if they were deprived of arms. Actually, the relation between the possession of arms and the issue of war and peace is the exact opposite from that which the advocates of disarmament assume it to be. Men do not fight because they have arms.

They have arms because they deem it necessary to be prepared to fight. The cause of war must be sought in the social conditions which make it inevitable that the struggle for power be fought with threats of violence, and which may make war appear to be the lesser of two evils. In these conditions must be sought the disease of which the desire for, and the possession of, arms is but a symptom.

The elimination of certain types of weapons, such as atomic bombs, would in itself have no influence upon the incidence of war; it could only affect the technology of warfare and, through it, the conduct of hostilities. The effective prohibition of atomic bombs would simply tend to stabilize the technology of war in the field of high explosives on the level on which it operated on the morning of July 16, 1945, when the first atomic bomb was exploded. Under the conditions prevailing at present in the society of nations, the nations adhering to the prohibition of atomic bombs would then be free to employ their resources for the development of weapons other than atomic bombs. Whether this would be a gain for humanity, in view, for instance, of the potentialities of guided missiles and bacteriological warfare, is an open question. In any event, the effective prohibition of atomic bombs by itself would leave the incidence of war exactly where it was before.

Furthermore, the effective prohibition of atomic bombs would in all probability reduce the technology of warfare to the pre-atomic level only at the beginning of the war. For while it is legally possible to outlaw the atomic bomb, it is impossible to outlaw the technological skill to produce atomic bombs. This has been the reason why the prohibition of particular weapons has generally not been effective in war, e.g., the prohibition of the use of lightweight projectiles charged with explosive or inflammable substances, of the bombing of civilians from airplanes, and of unlimited submarine warfare.

HISTORICAL PRECEDENTS

From 1816, when the Czar of Russia proposed to the British Government the "simultaneous reduction of the armed forces of every kind," to the present, there have been more than a score of major attempts at disarmament. Of these only two resulted in genuine disarmament: the Rush-Bagot Agreement of 1817, and the Washington Treaty for the Limitation of Naval Armaments of 1922. Both were the technical manifestations of political settlements, and their results in the field of disarmament lasted as long as the political settlements to which they owed their existence. The Rush-Bagot Agreement providing for naval disarmament on the Great Lakes is predicated upon the absence of a competition for power between the United States and Canada, which might transform itself into an armed quest for each other's territory. It is upon this permanent absence of political conflict between the two nations that the permanence of the naval disarmament, agreed upon in 1817, depends.

WASHINGTON TREATY OF 1922

The Washington Treaty of 1922 established approximate equality of capital ships between the United States and the British Empire, with the strength of Japan, France, and Italy trailing the English-speaking countries in this order. In consequence, the United States, the British Empire, and Japan scrapped about 40 per cent of their strength in capital ships. It was furthermore stipulated that replacements, to begin in 1931, should establish by 1942 a 5 : 5 : 3 : 1.67 : 1.67 ratio for the capital ships of the British Empire, the United States, Japan, France, and Italy. Here again, it was the absence of political conflict or the settlement of outstanding political issues which made at least partial disarmament possible, and with the revival of political conflict disarmament yielded to a renewed armaments race issuing in war.

The United States sought parity with Great Britain in battleship strength. She was bound to achieve that parity because of her superior and militarily uncommitted industrial resources. The only question was whether she would achieve parity by way of bitter and costly competition or by way of mutual agreement. Since there was no political conflict between the two countries which would have justified such competition, the two countries agreed upon a practically identical maximum tonnage for the battleships of both.

Furthermore, the First World War had made Japan the preponderant naval power in the Far East, thus threatening the interests of the United States and Great Britain in that region and inviting them to a naval armaments race. Such a race, however, the United States, for financial and psychological reasons, was anxious to avoid. Great Britain, on the other hand, was tied to Japan by a military alliance. More particularly, the British dominions dreaded the possibility of finding themselves on the Japanese side in the event of a conflict between Japan and the United States. Thus, Great Britain and the United States not only were not separated by political conflicts which might lead to war; they had also an identical interest in avoiding an armaments race with Japan. By dissolving the alliance with Japan and agreeing to parity with the United States on a level she could afford, Great Britain solved her politico-military problems in the field of naval armaments. By separating Great Britain from Japan and reaching parity with Great Britain cheaply, the United States, too, obtained what she wanted in that field.

This understanding between the United States and Great Britain not only isolated Japan but placed her at the same time in a position of hopeless inferiority with regard to heavy naval armaments. Instead of embarking upon a ruinous armaments race which she had no chance of winning, Japan made the best of an unfavorable and humiliating situation: she accepted her status of inferiority for the time being and agreed upon stabilizing this inferiority at the ratio mentioned above. When the Anglo-American reaction to Japan's invasion of China at the beginning of the thirties showed that the united front of Great Britain and the United States with regard to the Far East, which had made the Washington Treaty of 1922 possible, no longer existed, Japan at once freed herself from the shackles of that treaty. As far as the Japanese position vis-á-vis the Anglo-American naval supremacy was concerned, the disarmament provisions of the Washington Treaty were the product of a peculiar political situation. These provisions could not survive the political conditions which had created them.

THE PRESENT CONFLICT OVER ATOMIC DISARMAMENT

The conflict between the United States and the Soviet Union over atomic disarmament, enacted on the stage of the United Nations Atomic Energy Commission, reveals itself, too, as a mere reflection of the underlying struggle for power. This conflict was essentially a new production of the play which was staged at the World Disarmament Conference in the early thirties. The United States played the role which France played up to the First World War, and the Soviet Union recited the text which Germany made familiar to the world. The issue, in the language of disarmament, was

nopoly of the atomic bomb gave the United States a military advantage over the Soviet Union which the United States was willing to give up only in return for adequate guarantees against any other nation's being able to produce atomic weapons. During the period of transition from an atomic armament race to the abolition of all atomic arms, guaranteed by international safeguards, the United States would have retained her superiority. This superiority would have been fully and definitely relinquished only at the end of that period when the system of international guarantees would have proved to be in working order.

The Russian conception of atomic disarmament reversed the sequence which the American plan envisaged. Instead of security first, equality later, the Russian conception postulated the immediate establishment of equality, the creation of guarantees against the production of atomic arms to be left to later negotiations, which might or might not succeed. If this state of affairs could actually have been brought about, it would have given the Soviet Union two military advantages. On the one hand, it would have wiped out with one stroke the superiority of the United States over the Soviet Union in atomic weapons. On the other hand, it would have given the Soviet Union her only opportunity of gaining superiority in atomic weapons over the United States. The Soviet Union would also have obtained equality in atomic weapons under the American plan, that is, the equality of zero, even though only in the future and with the proviso that this equality could never be transformed into superiority. The Russian plan would have given the Soviet Union the equality of zero right away and with it her only chance to become superior to the United States sometime in the future.

THE NATURE OF THE UNDERLYING POWER CONFLICT

The two fundamental facts which determined the policies of the two nations during that period were the temporary American monopoly of the atomic bomb and the military preponderance of the Soviet Union on the continents of Europe and Asia. The paramount interest of the Soviet Union was to make the period of American supremacy in atomic weapons as short as possible, while perpetuating this preponderance. The United States was vitally interested in maintaining her monopoly of atomic weapons as long as possible and in reducing the Russian superiority on the two continents. The policies of both countries regarding disarmament were the true reflection of those facts and interests.

The conflict between the United States and the Soviet Union, like that between France and Germany of the early thirties, then, was fought on two levels: on the superficial level of disarmament and on the fundamental level of the struggle for power. On the level of disarmament the conflict resolved itself into a controversy between two theoretical conceptions: security first, equality later *vs.* equality first, security later. On the level of the struggle for power, the conflict is posed in terms of two antagonistic policies: defense of the status quo *vs.* overthrow of the status quo. The American insistence upon security is the equivalent, in terms of atomic disarmament, of the American policy of the status quo, as the Russian emphasis upon equality is the expression, in terms of atomic weapons, of the Russian policy of expanding and making unassailable the ascendancy of the Soviet Union in Europe and Asia.

Such is the nature of the power conflict between the United States and the Soviet Union. Of this conflict the controversy on atomic disarmament is but an outward expression, following the contours of the conflict as the cast of clay follows the shape of the form into which it is molded. As the cast can only be changed by changing the mold, so the problem of atomic disarmament can only be solved through a settlement of the power conflict from which it has arisen.

The political factors which have obviated the attempts at atomic disarmament will inevitably militate against disarmament with regard to the H-bomb. As long as the struggle for power between the United States and the Soviet Union rages unabated and unsettled, the impasse with regard to disarmament will continue, whatever type of weapon may be chosen as an object and however ingenious a legal formula and institutional device may be contrived to make disarmament effective could it be agreed upon. Shall we then persist in an error which led the United Nations Atomic Energy Commission into an impasse, which condemned the World Disarmament Conference of the thirties to futility, and which for more than a century and a half has strewn the road of humanity with disappointed hopes and ever more frequent and destructive wars? Are we to continue trying to doctor the symptoms and let the disease, unattended, take its deadly course?

THE ILLUSIONS OF PEACE

Peace through competitive armaments is indeed an illusion. As Lord Grey put it in melancholy retrospect upon the origins of the First World War in which he had so prominent a part:

> More than one true thing may be said about the causes of the war, but the statement that comprises most truth is that militarism and armaments inseparable from it made war inevitable. Armaments were intended to produce a sense of security in each nation—that was the justification put forward in defence of them. What they really did was to produce fear in everybody. Fear causes suspicion and hatred; it is hardly too much to say that, between nations, it stimulates all that is bad, and depresses all that is good.
>
> One nation increases its army and makes strategical railways towards the frontiers of neighbouring countries. The second nation makes counter-strategical railways and increases its army in reply. This first nation says this is very reasonable, because its own military preparations were only precautions; the second nation says that its preparations also were only precautions, and points out with some cogency, that the first nation began the competition; and so it goes on, till the whole Continent is an armed camp covered by strategical railways.
>
> After 1870 Germany had no reason to be afraid, but she fortified herself with armaments and the Triple Alliance in order that she might never have reason to be afraid in the future. France naturally was afraid after 1870, and she made her military preparations and the Dual Alliance (with Russia). Britain, with a very small Army and a very large Empire, became first uncomfortable and then (particularly when Germany began a big-fleet programme) afraid of isolation. She made the Anglo-Japanese Alliance, made up her quarrels with France and Russia, and entered into the Entente. Finally, Germany became afraid that she would presently be afraid, and struck the blow, while she believed her power to be still invincible. . . .
>
> The enormous growth of armaments in Europe, the sense of insecurity and fear caused by them—it was these that made war inevitable. This, it seems to me, is the truest reading of history, and the lesson that the present should be learning from the past in the interest of future peace, the warning to be handed on to those who come after us.

But it is no answer to the illusion of competitive armaments to counter it with the illusion of disarmament. Both are symptoms of the underlying political relations—either of a raging political conflict or of a political conflict peacefully settled. Disarmament is indeed an indispensable step toward pacification, but it cannot be the first

step. It is the result of political settlement, never its precondition. As long as the United States and the Soviet Union advance contradictory claims for the domination of Europe, of which the focus at present is Germany, it is idle for them to talk about disarmament; for they are forced by the very logic of this power contest to compete for armaments. The threat of atomic destruction can be met only on the level from which it arises, that is, the political level. If we cannot settle the political conflicts which threaten to involve us in war with the Soviet Union regardless of the prevailing technological conditions, we must face, as we must threaten, destruction with the latest technological means of destruction available to men. If the United States and the Soviet Union can settle these conflicts peacefully by safeguarding their vital interests and compromising on secondary issues, the technological progress of mankind will, by that very fact, have lost its threat. They can then afford to agree upon limitation of their armaments. Disarmament, in turn, will contribute to the general pacification. For the degree of the disarmament agreed upon will be the measure of the political understanding achieved.

POLITICAL SETTLEMENT THE SOLE HOPE FOR PEACE

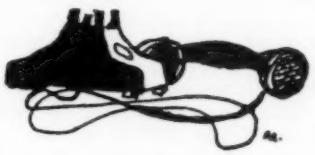
There are only three ways by which international conflicts can be settled: overwhelming power, war, negotiations. Since overwhelming power is no longer at our disposal and beyond our grasp for the forseeable future, the choice is between war and negotiations. Consequently, Mr. Churchill and the Vatican, not to mention some of the wisest and most experienced American observers, have called for direct negotiations between the United States and the Soviet Union. It is indeed in the success of such negotiations that the sole hope for peace resides. If we do not dare to face the realities of the power conflict in which we are engaged, and if we cannot hope to settle it peacefully on its own level, we cannot hope for peace. The concentration of our efforts upon illusory disarmament, then, becomes a mere evasion of the issue of life and death, the indulgence in primitive "concrete" thinking which confounds appearance with substance, symptom with cause, the pastime of political children at the rim of the abyss, a wasted effort on the eve of universal disaster.

Senator Tydings Asks Disarmament Conference

SPEAKING before the Senate on February 6, Senator Millard E. Tydings (D. Maryland) reintroduced a resolution which he had originally introduced in 1946. The resolution requests the President to call a world disarmament conference to accomplish universal disarmament within the next four years. The Senator maintains that atomic disarmament alone, even if it could be achieved, would offer only illusory security and be no more than an "atomic truce" between wars.

"Even though an agreement is reached for control and for inspection, if any war between the great powers begins, the hydrogen bomb will be used anyway." He continues, "The minute such a war breaks out the great nations of the earth capable of doing so will commence the manufacture of such bombs because they cannot trust each other, and because if they do not have the bombs, they will be at the disadvantage of quickly losing a war which they otherwise might conduct successfully for years, if necessary.

"The situation requires bold treatment. We are not faced with a flood or a famine or a typhoon or a tidal wave. We are faced with the extinction of all human beings on the earth as the march of events and of science proceeds on its way down the roadway of the future."



Chicago Atomic Scientists Offer Free Legal Counsel to AEC Employees

THE Atomic Scientists of Chicago, Chicago chapter of the Federation of American Scientists, this month retained a member of the Chicago Bar to provide free advice and guidance to any employee at any atomic installation or laboratory in the Chicago area. The purpose of this, it was announced, is to prevent employees from resigning their positions without review of the security doubts raised against them. With this plan, the group hopes to reduce the loss of employees who may serve the national program to those judged poor security risks by AEC criteria applied in impartial hearings.

The plan entails a free conference which will be entirely confidential. If further counsel is necessary, the client can then retain the Association's lawyer at his own expense or secure another lawyer of his choice.

Details of the plan may be obtained from the Atomic Scientists of Chicago at the University of Chicago (MIdway 3-0800—Ext. 1414).

Letter to the Editors

DELFT, HOLLAND
January 23, 1950

DEAR SIRS:

Newspapers are telling us that in your country a serious discussion is going on concerning the possible use of a "hydrogen bomb," which is alleged to have an effect perhaps a 1,000 times more than that of a bomb loaded with uranium or its derivatives.

There is but one thing which we Europeans can say to this:

We ask the American people and its Government to decide not to use such bombs in any conflict, on the ground of Christ's teachings.

We do not preach nonresistance. We recognize that protection is necessary and that this involves defensive measures.

But to decide not to use a weapon because it entails too heavy moral conflicts and because it endangers the inhabitability of the earth, is a proof of moral strength, which will bring relief in the present tensions and win sympathy for the United States everywhere.

The gain in confidence which it will call forward in all democratic countries will be the most hopeful method for increasing both their and your resistance against any insidious attack.

Yours very sincerely,
J. M. BURGERS

Professor,
Laboratorium voor
Aero-en Hydrodynamica
der Technische Hoogeschool

A NEW BID FOR ATOMIC PEACE

Brien McMahon

We here present the text of Senator Brien McMahon's dramatic peace proposal given before the U. S. Senate on February 2. Senator McMahon, Democrat, of Connecticut, is the author of the Act under which the American atomic energy program operates and is the present chairman of the Joint Congressional Committeee on Atomic Energy.

THE President of the United States has now given orders to build the hydrogen bomb—to create, in deliverable quantities, those chunks of the sun technically known as thermonuclear weapons.

The scientists feel more confident that this most horrible of armaments can be developed successfully than they felt in 1940, when the original atomic bomb was under consideration. The hydrogen development will be cheaper than its uranium forerunner. Theoretically, it is without limit in destructive capacity. A weapon made of such material would destroy any military or other target, including the largest city on earth.

The President's decision was dictated by the severe realities of the world which we inhabit today. He had no choice, and his decision under present circumstances is right.

THE FOLLY OF DISARMAMENT BY EXAMPLE

American renunciation of the hydrogen bomb would mean embracing the folly of "disarmament by example." Our friends abroad would shrink away from us, seeing that we had lost power to defend the United States, much less to help defend Europe.

Densely populated American cities are made-to-order for an explosive that levels hundreds of square miles. Factors such as these serve to warn America against complacency.

Voluntary acceptance of the idea of being less well armed than other nations in this era of our greatest vulnerability runs completely counter to the traditions of our leaders—and, I might add, to good common sense. In my judgment, a failure to press ahead with the hydrogen bomb might mean unconditional surrender in advance—by the United States to alien forces of evil.

But please note my insistence that we possess no monopoly of the hydrogen bomb idea. If we win the race to build this weapon first, it is only a matter of time—and possibly a short time—before the Kremlin achieves success also. Let me warn, with all the solemnity at my command, that building hydrogen bombs does not promise positive security for the United States; it only promises the negative result of averting, for a few months or years, well-nigh certain catastrophe.

Do not for a moment overlook the obvious—that Soviet Russia broke our atomic bomb monopoly sooner than we had expected, and she would break any hydrogen bomb monopoly that we enjoyed with equal or greater speed. We are plunged into a truly terrible arms race!

What are we going to do about it?

Dr. Jekyll and Mr. Hydrogen
(Bruce Russell in the Los Angeles Times)

DANGERS TO FREEDOM IN PROLONGING THE COLD WAR

There are really, I suggest, no more than two broad policies from which to choose. One consists in resigning ourselves to a generation of waging the "cold war"—that is, striving endlessly to contain Russia's outward pressure, pouring out our substance to stay ahead in the weapons competition even after the Kremlin becomes armed with hydrogen bombs, and cherishing indefinitely the hope that Soviet tyranny will somehow see the evil of its ways and reform itself from within.

Arrayed against the choice of such a policy is five thousand years of recorded history, which teaches again and again and again that armaments races lead to war—under today's conditions, hydrogen war!

But even if this policy could enable us to avoid armed conflict for a whole generation, it would undermine and corrupt that which we prize more highly, even than the absence of hostilities: I refer to liberty. How is it possible for free institutions to flourish or even to maintain themselves in a situation where defenses, civil and military, must be ceaselessly poised to meet an attack that might incinerate fifty million Americans—not in the space of an evening, but in the space of minutes?

Consider what sustained fear does to the individual—especially to the individual enterpriser. It constricts his imagination, paralyzes his initiative, and even affects his personal morality. It constitutes the most subtle and potent of poisons. Consider the

crushing burdens already imposed upon our private enterprise economy. Consider too, the restrictions on freedom already brought about by the atomic bomb and by its pressures upon us to accept loyalty checks, espionage counter-measures, and widening areas of official secrecy.

For a preview of the future if the armaments race continues, multiply the effect of these factors by something like 1,000 times—to allow for the 1,000-times greater energy release of the hydrogen bomb—and if you are candid and realistic, I believe you will find it is difficult indeed to see a dominant role for freedom in such a picture. To stay alive we will find ourselves more and more compelled to imitate the totalitarian rival.

AMERICAN MOVES TOWARD INTERNATIONAL CONTROL

The other broad policy which we may choose consists in moving heaven and earth to stop the atomic armaments race, to establish world-wide atomic peace, and to make possible atomic-created abundance among all men.

It was from this kind of philosophy that we generated our original proposal for international control—a proposal which should constitute a source of pride to every citizen of our land.

In essence, we offered to share all that is good in atomic energy, and we asked only for the minimum safeguards, as operative upon ourselves as upon others, that would prevent the evil in atomic energy from being used to destroy us.

We proposed that men of all countries, including Russians, come to America under the auspices of the United Nations and inspect our atomic activities, and share in the control of our atomic raw materials and the operation of our atomic plants—all for the purpose of assuring themselves, to their own complete satisfaction, that we had honored our promise to exploit the atom for peace and peace alone. Equally we proposed that the same just and necessary protective measures be made effective throughout the globe.

FRESH PROPOSAL FOR ATOMIC PEACE NEEDED

It is my intense conviction that our decision, born of necessity, to build the hydrogen bomb must be accompanied by the immediate initiation of a moral crusade for peace having far greater potential effect than any physical weapon, even chunks of the sun.

Yet, we have already undertaken one major peace effort—and it was unsuccessful in that today we remain as far distant from atomic agreement as when we started. Why did this honest peace effort fail to have a successful impact upon all mankind?

IRON CURTAIN THE GREAT OBSTACLE TO PEACE

The answer is obvious and may be summarized in three words: Russia's Iron Curtain. The people of Russia, thanks to the Iron Curtain, have been prevented from knowing the true and desperate nature of the atomic crisis.

They have been kept from learning, owing to the Iron Curtain, how we extend toward them the hand of friendship and offer a just atomic control plan for their protection and incalculable benefit as well as our own. Any information on the subject that reaches the Russian people is first twisted and distorted into the Red focus of the Kremlin's official line.

We all know why the Soviet elite members maintain their curtain. It is because, using Churchill's phrase, "They fear our friendship more than they fear our enmity." You cannot operate a prison with too many doors and windows unguarded and unlocked. The men of the Kremlin do not want us to look in. Above all, they do not want their own people to look out.

It is completely accurate to say that, in final analysis, Russia's Iron Curtain is responsible for our enormously reluctant decision to make hydrogen bombs—for the curtain prevents the Russian people from appreciating that we want and seek atomic peace; they, therefore, bring no effective pressure upon their rulers to accept atomic peace; the rulers maintain their absolute sway through popular ignorance; and the atomic armaments race rushes madly onward.

But though we may justly blame the Iron Curtain, we must also blame ourselves for failing to bring our message of peace and conciliation adequately to the attention even of those people who enjoy reasonably free access to information.

Few of our own leaders have recognized that global control of atomic energy is the question at the heart of all foreign policy, and that the German dilemma, the Austrian treaty, the status of Japan, and like matters are relatively insignificant compared to the overriding issue of whether or not more atomic weapons shall enter into existence with each month and year which passes.

If a new crusade for peace is not to miss its objective, as did the peace effort which we launched with such high hopes in 1946, we must not only crack the Iron Curtain and gain the ear of the Russian people—we must also gain the ear of people on the near side of the barrier, including the many in our own country who do not yet grasp what is at stake.

THE "WHISPER" OF AMERICA

We have spent $29,000,000 a year on what we are pleased to call the Voice of America. It should be called the Whisper of America. We spend over $30,000,000 a year to advertise cosmetics—and $29,000,000, I repeat, to sell the precious commodity of freedom!

All over the world today—perhaps because listlessness and mediocrity have characterized our attempts to sell what America is, what America wants, and what America intends—there exists misunderstanding as to our attitude.

There are millions of people abroad who observe our armaments expenditures and fail to grasp that these are for self-defense.

They should appreciate the truth, but they do not. We assume that our actual good intentions and actual good feelings must be known to them; but they see that we devote billions to guns, tanks, planes, and atomic weapons—and day and night the Communist propaganda machine hammers into them the theme that American armaments are designed for conquest.

Even worse, they do not see—at least with the same clarity—the huge resources being diverted to munitions inside Russia; for the Iron Curtain conceals such activity and even enables Mr. Vishinsky to deceive multitudes by claiming that his country uses atomic energy to "move mountains."

I advocate, Mr. President, a United States program of attention-arresting foreign broadcasts that would compare in size and scope to the Soviet effort along this line and that would genuinely deserve the name, Voice of America. I favor exploring the effi-

cacy of printing millions of leaflets for world-wide circulation, explaining a new United States proposal for atomic peace.

We should publicly and repeatedly challenge the Kremlin to make known the terms of this proposal to newspaper readers and radio listeners inside Russia. We should publicly and repeatedly challenge the Kremlin to permit a meeting of the United Nations in Moscow, so that the trend of international discussions and our own sincerity would be more likely to enter the mental horizon of the average Russian.

There are other possible methods of creating a window in the Iron Curtain. Some have already been made known to the Senate; others will occur to us if we give the problem sufficient thought; all should receive the most painstaking scrutiny. At almost any cost we must assure that the Russian people have opportunity to consider, side by side, the atomic proposals of their own rulers and our atomic proposals, and that the Russian people act as part of the world jury which brings in a verdict covering this monumental issue.

There remains the question of what fresh atomic offers we should advance as means of igniting a moral crusade for peace. Recently some observers, quite properly conscious of the decisive position occupied by atomic energy, have argued that a board should be appointed (analagous to the one which prepared the famous American report in 1946) and that such a board should take a "new look" at the entire control problem—especially with a view toward re-evaluating the need for certain technical phases of what is now the United Nations plan.

Yet the scientific facts surrounding the hydrogen bomb more than ever render necessary the general kind of technical program which the United Nations, after exhaustive study, has approved. More than ever it is true that an ineffective agreement would be worse than no agreement at all. More than ever there is no escape from strict control of raw materials, strict control of plants, and continuous inspection. We can enter into no scheme of a type which would only serve to mislead us and induce a false sense of security.

PROPOSAL TO OFFER TEN BILLION AMERICAN DOLLARS A YEAR TO FOSTER PEACE

The new approach that I have in mind is somewhat different. Although it flows from many weeks—and indeed months—of continuous reflection, I offer it only as an example of the bold steps which the Soviet atomic explosion, the shadow of the hydrogen bomb, and the pyramiding arms race should persuade us to consider.

We now spend about $15,000,000,000 annually for armaments. Why not offer to take two-thirds of this sum, or $10,000,000,000, and, instead of amassing sterile weapons, use it to foster peace throughout the world for a five-year period? Why not offer to spread the annual $10,000,000,000 over three programs: President Truman's Point Four proposal, development of atomic energy everywhere for peace, and general economic aid and help to all countries, including Russia?

Such a global Marshall Plan might combine with the marvelous power of peacetime atomic energy to generate universal material progress and a universal cooperative spirit.

EFFECTIVE CONTROL THE QUID PRO QUO

In exchange for our own contribution of $10,000,000,000 annually, we would ask: (1) general acceptance of an effective program for international control of atomic energy; and (2) an agreement by all countries, enforced through inspection, that two-thirds of their present spending upon armaments be devoted toward constructive ends. Administration of the annual $10,000,000,000 which we offered to make available would be carried out through the United Nations.

Such a proposal, if advanced by our Government, might vividly bring home to all the world's population—in a manner far more successful than we have so far used—the profundity of our desire for peace. It would accomplish this result even if it accomplished nothing else.

If the proposal were actually accepted, we would have concluded the cheapest monetary bargain in our history; we would have probably saved mankind from destruction by fire. It is almost impossible to overestimate what all-out concentration upon atomic energy for peace might accomplish in terms of remaking and improving the physical environment of mankind.

I might point out that we have already poured billions into foreign economic aid, asking nothing in return, and still communist propaganda has blackened our motives in the eyes of millions. Here, in accordance with my suggestion, we would ask effective control of the atom and substantial disarmament—which every man and woman in the world has a right to expect without any further inducement on our part.

Yet we would, in fact, provide further inducement, in the form of $10,000,000,000 annually for five years, as proof of our overwhelming will to peace. At the same time it goes without saying that we would provide no such funds unless they were associated with the measures needed to rescue humanity from hell on earth—control of the atom and disarmament.

OUR FINAL OPPORTUNITY

I suppose that my suggestions will be termed impractical or theoretical in some quarters. Before they are condemned, however, I would ask that whoever condemns them produce a better proposal.

I am willing to have my suggestions today judged against the background of Mr. Baruch's words spoken more than three years ago—which I now repeat:

"We are here to make a choice between the quick and the dead.

"That is our business.

"Behind the black portent of the new atomic age lies a hope which, seized upon with faith, can work our salvation. If we fail, then we have damned every man to be the slave of fear. Let us not deceive ourselves: we must elect world peace or world destruction."

This much Mr. President, I would add: in 1945 and 1946, when our thoughts were focused upon the Hiroshima bomb, we enjoyed an opportunity to wage atomic peace that somehow—despite the magnificence and generosity of our proposal to the United Nations—we did not fully exploit. Our present concern with the hydrogen bomb furnishes a second opportunity. I do not think a third will be given us.

I believe that every morning each member of the United States Senate and House of Representatives, and each high official of the executive branch, should glance at the sun and reflect that what he sees there, millions of miles away, threatens to be recreated on this earth, in our own cities, in Washington, New York, Los Angeles, and Chicago.

This is a time for soul-reaching, for nation-wide and world-wide debate, and for the launching and maintaining of that moral crusade for peace which alone can save us and lead mankind along the righteous paths of security, abundance, and liberty.

PHYSICISTS AND THE COLD WAR

Frederick Seitz

In the face of the increasing tensions of the cold war, what is the physicist's duty? Can he with good conscience devote a larger portion of his time to military research? These are some of the questions explored in the following article by Dr. Frederick Seitz, Research Professor of Physics at the University of Illinois. The paper is based on a speech given at a meeting of the American Physical Society held in New York early in February.

IT HAS been obvious since about 1946, and after the period of debate centering about the McMahon Act, that the relationship between Russia and the other nations of the wartime alliance were badly strained. Moreover, these relations have deteriorated steadily since then. We now find ourselves in a period of turmoil somewhat reminiscent of that which existed in the years preceding 1939, although there are profound differences.

As an introduction to stating my own opinion of the course to be followed by physicists in this situation, I should like to attempt to classify the principal views that are possible; a given individual may compose his own view of a combination of these. There are, I believe, three possible viewpoints; I have friends who possess each of these in relatively pure form:

1. First, it is possible to take the attitude that we should do relatively little of a positive nature to influence the existing situation. Russia, for reasons good or bad, has a deep distrust of our motives and a profound sense of insecurity. Matters will improve if we do not press them; we should not attempt violent discussions at the meeting of the United Nations or press the issue of the Atlantic Pact. Those who support this viewpoint exclusively believe that we should not expand our arms program.

2. A second viewpoint is that we should pursue peace in a very vigorous sense. At one end of the scale is the opinion that supporting the United Nations' program is sufficient; at the other end is the opinion that we should make extensive unilateral agreements with Russia to aid her in repairing the damage wrought by the Germans and that we should recognize the neutrality of large regions of the world.

3. The third viewpoint is that we should arm ourselves and those nations which will join us in a close union which combines cultural, economic, and military affairs. One segment of the group holding this opinion feels that it will lead to a United World Government in which the Russians will eventually participate. Another believes that it is a form of sound practical insurance which may prevent the Russians from resorting to arms. Still a third believes that it should be used as a means of launching a preventive war. The last-named segment represents a very distinct minority at present.

It is clear that certain combinations of the second and third viewpoints are compatible. For example, it is possible to arm the nations of the West and still pursue peaceful planning within or without the framework of the United Nations. This, in fact, is the plan which I believe we should follow in a highly coordinated manner and much more vigorously than we are doing at the present time.

The viewpoint that anyone adopts depends upon many factors in his make-up; it will be based upon both emotion and logic. The principal logical basis of my viewpoint is as follows:

THE EVOLUTION OF WESTERN IDEALS

The awakening of Western Europe that is normally termed the Renaissance brought something into the lives of men that had never before existed in anything like as extensive a manner. The materialistic changes which accompanied the Renaissance, and which are often given principal emphasis at the present time, are of a quite secondary and superficial nature. The important revolution that was ushered in with the Renaissance was one of attitude of mind; it was, in fact, a major revolution in the philosophy of life. The basic idea was that the minds of men should not be bounded in the larger sense by any pattern of dogma or tradition, but should be free to explore all aspects of life in all fields without restraint. Most of the important aspects of the development of Western civilization during the past six hundred years can be understood on the basis of the gradual emergence of this principle as the dominant theme of life. The emancipation of the mind did not take place instantaneously. The unit of measure of time is a century: each century brought significant advances as field after field became increasingly free of dogma. The freeing process is by no means complete; rather, it should be said that the revolutionary idea of the Renaissance is an ideal which we may expect to approach only asymtotically. The most classical examples of the process of freeing lie in the fields of art, religion, and science in which great diversity and splendor accompanied the acceptance of the new ideal. Actually it has affected almost every phase of living in a very remarkable way. With it are associated the introduction of republican democracy, the wide expansion of technology and commercialism, the development of the modern university. An historical phi-

losopher has referred to this process of development as the quest for the infinite and has designated this the trademark of our civilization. Many previous civilizations have had some of the features of ours; none has had the infinite profusion of degrees of freedom.

It is interesting to note that there are within our civilization individuals and groups of individuals whose philosophy of life is entirely restricted or one-dimensional. However, these individuals or groups coexist in comparative harmony with other individuals and groups whose restrictions are entirely different. There is, in other words, an underlying *motif* of tolerance. There is no universal catechism unless it be the statement that there is none.

THE NAZI DEFECTION

There was a very critical period during the Renaissance when the question of this expansion in search of the infinite was touch and go. We are all familiar with the trials of Galileo and the struggles of the Reformation. Once this period was past, the process moved swiftly in Western Europe and on this continent until the present century. The first major set-back was represented by the program of the Nazi regime in Germany which can be understood best within the framework of the historical prospective I have just outlined.

In brief, the Germans desired to condense the program of human affairs to a more simple and primitive one—in fact, a one-dimensional one. Almost the entire program can be understood on this basis. Had the Germans succeeded, the effects of their success would have admitted of no simple compromise. The goal of modern life would have been changed to something far more primitive. It is interesting to speculate on the fact that this was the first major defection within the Western group since the sixteenth century. Perhaps it is only now that technology has developed so far that it becomes possible to hope to confine the expanding mind and establish again a universal dogma.

THE EVOLUTION OF RUSSIAN CULTURE

Where does Russia fit into this framework? Russia did not participate in the Renaissance until well into the eighteenth century because of a great tragedy in her history. In the Middle Ages, Russia centered its life about the Ukraine and the region extending north to the Baltic, with Kiev as the capital. At this time there were intimate cultural and trade relations with Western Europe. Had this state of affairs continued unaltered, Russia would have undoubtedly been a major contributor to the Renaissance, and the development would have been greatly enriched. Unfortunately, a Tartar invasion in the thirteenth century reduced most of the population to a state of peonage. The Tartars were finally overcome through the efforts of the Duchy of Moscovy, which was sufficiently far from the main center of medieval Russia and in a sufficiently poor area that the Tartars did not conquer it. This group formed the nucleus of modern Russia. When it emerged in the fourteenth and fifteenth centuries, it established its own cultural pattern since it had remained isolated from Western Europe. In the sixteenth century when all Western Europe was beginning to flower, the Muscovites, under Ivan the Terrible, imposed new and harsh restraints upon the peasants, which kept most of the population in a state bordering slavery until about the time of our Civil War. It is true that, starting with Peter the Great in the early eighteenth century, some Western ideas were introduced into Russia. These, however, affected in the main a very limited segment of the population. Many good things in the Western sense resulted from this. The flowering of art and science in the nineteenth century was comparable to the best produced in the West. No one can claim, however, that this influence extended throughout the population, or that the average Russian mind was ever as free as the Western mind in the same period.

The 1917 Revolution seemed at first to be a step which would greatly accelerate the process of Westernization. It appeared that Soviet Russia might furnish a new and virile leadership in the best Western sense. Perhaps the course followed during this period was based merely on expediency. Whatever the case may be, the simple truth at present is that the Soviet leaders have abandoned the idea of the Renaissance and are now in the process of developing a pattern of culture as burdened with dogma, as nearly one-dimensional, as anything known in the last millenium. The accepted one-dimensional pattern of the day is called the "line." Deviationism, or divergences from this line, are not tolerated. This policy is the antithesis of the ideal of the Renaissance. The full meaning of the development in Soviet Russia at present can be fully appreciated only if this point is clear.

Many people are misled in judging Soviet Russia, I believe, because there remain vestiges of the periods when the Russian mind had comparative freedom, just as there remain within Western society vestiges of darker centuries. As the Soviet leaders gradually tighten their grip on the nation, however, the influence of the great difference in ideals emerges with increased clarity.

IMPOSSIBILITY OF COMPROMISE BETWEEN THE TWO IDEALS

Since the underlying ideal of life in the West and in Russia is so completely different, I do not believe that any genuinely broad compromise is possible between the two systems without producing enormous changes in either or both. We may compromise on minor issues, such as German reparations or currency. However, if Russia were to accept the concept of freedom of the mind which guides our civilization, the resulting revolution in internal structure would be as great as those which accompanied the French or American revolutions; in fact, it would be fully as great as the changes induced by the Revolution of 1917 appeared to be during the first years of the twenties. What is more to the point, should we attempt, either voluntarily or as the result of force, to make our pattern conform to the Russian one as it exists today, we should be making a completely violent break with the ideal that has been our guiding star for over five centuries. The influence of this ideal is so great in all aspects of our life and has so permeated even our most mundane thoughts that the life we would live thereafter would be fundamentally different from that we live now. We might retain most or all of the material benefits we possess today (although I sincerely doubt this), but we would be compelled to forsake our most cherished traditions concerning freedom of self-expression.

This does not mean that we are automatically doomed to military conflict with Russia or that a struggle to the death is necessary. There are many instances in the past where rather different cultures have lived alongside one another in relative peace. The Mohammedan world and the Christian world coexisted for nearly a thousand years during the Middle Ages with occasional clashes such as those which occurred during the period of

the Crusades and the struggles in Spain and the Balkans.

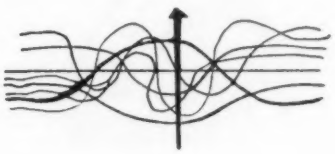
It is not difficult to envisage a state of affairs in which Russia and the West could live in comparative peace, each culture maintaining its own internal equilibrium. The maintenance of such a state would pose far greater problems than those which arose between the Christian and Moslem worlds primarily because of the tendency of minor border incidents, like those which flared up sporadically between the Christians and Moslems, to grow into major conflicts at the present time.

COMPLETE NEUTRALITY IMPRACTICAL

In fact, I am inclined to believe that the only condition under which a tranquil peace could be maintained would be one in which the world would be divided rather rigidly into units, surrounded by relatively impermeable walls, and between which there would be a very limited flow of culture. Commercial relations and the exchange of technical information might be permissible on a relatively extensive scale, but there would have to be perfect understanding that all types of proselytizing would be taboo across the borders of a given unit. The exchange of culture would be very low between Russia and the West; this might not be the case between a unit centering about India and the West. Above all, the maintenance of equilibrium would require that each unit have complete faith in the benign intentions of the others. If this state of affairs existed at the present time, those who advocate essentially complete lassitude in all forms of international endeavor between Russia and the West would be essentially correct. In fact, it probably would be wise to abandon almost entirely the present program of the United Nations, which might provide a source of continuous conflict. This organization could be replaced by one which would have much more modest goals and would deal principally with methods of exchanging material goods and with similar problems.

It is apparent, however, that at the present time Russia and the West are far from a state in which proselytizing is taboo. Western civilization has almost abandoned the cruder methods it used in the past and could easily abandon the present techniques based on stimulation of trade, education, and Christianity. Even if this were done, it is likely that Western ideas would continue to spread because the influence of the West is now so great. Russia, in contrast, seems compelled to employ the crudest methods of proselytizing because Soviet culture would probably stop at its present boundaries if the Comintern followed this same procedure. This, in fact, is probably the greatest dilemma Soviet Russia faces today. It is this situation which makes it exceedingly unlikely that her leaders will abandon the present policy unless it proves to be less practical than an alternative.

In brief, we must find methods of making it impractical for Russia to follow her present policy of proselytizing if we do not want Western civilization to be overwhelmed. We will not achieve that goal by adopting a program of complete neutrality.



IMPORTANCE OF MILITARY PREPAREDNESS

What steps should be taken? I believe that at the present time the best path to follow is a combination of two possibilities mentioned in the introduction. First, we must have a vigorous program of international negotiation by which we continue to render economic support to the nations outside the Russian sphere of influence and continue to propose international disarmament under conditions which make it reasonably clear that the disarmament program is being followed in all nations, that is, under conditions which permit adequate inspection. This program may well include the extension of economic aid to Russia. Second, we must maintain the military strength of the Western nations at a level so great that Russia will not be willing to attack us without grave danger to herself. This level must be raised substantially in the near future if Russia continues her present policy of unrestricted armament. It can be lowered only when a general agreement has been reached with Russia under conditions which indicate that she has sincere intentions of keeping it. Granted that a revolution within Russia is exceedingly unlikely in the immediate future, we should work toward a state of affairs in which explicit proselytizing ceases, and preferably one in which there is general disarmament. This policy evidently involves very great risks, particularly if we must begin with an acceleration of our military program, but I doubt that there is an alternate which offers fewer risks.

There have been a number of proposals of explicit programs involving diplomatic negotiations which might achieve the state of armed tranquility described above fairly directly. There are, for example, plans such as those for the Atlantic Union and for World Federation, which are well known to all. There are also plans, such as that proposed recently by Szilard, in which Russia and the United States would agree to recognize the complete neutrality of nations which lie in zones of possible conflict, such as Western Europe. It is not my intention to discuss the merits or shortcomings of such plans here other than to agree that it is highly desirable to pursue some plan of this type vigorously in an attempt to reach an agreement with Soviet Russia before the present arms race proceeds much farther.

It might even be advisable to refrain from any acceleration of our armament program during the period of negotiation, but I do not believe we can afford to refrain from accelerating our arms program beyond the limits of the present year. Even a delay of this length of time may be unwise.

In the last analysis we must have faith that a way can be found through the forbidding maze of obstacles that stand before us if we maintain vigilance and those principles which have carried us so far in the past. This will not be the first storm that Western civilization has weathered.

LESSON OF THE BERLIN BLOCKADE

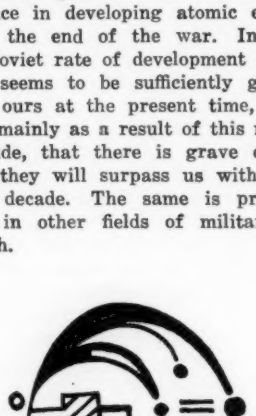
The importance of military preparedness at the present stage is probably best illustrated by the Berlin crisis. In initiating the Berlin blockade the Russian leaders evidently hoped to embarrass the United States before the eyes of the nations of Western Europe by demonstrating our weakness. We were able to outmaneuver the Russians, at least for the time being, only because we were physically prepared to undertake the airlift. It should be noted that our state of readiness for the situation did not automatically lead us to war because we kept the doors open for negotiation. The important generalization of this incident is that our diplomatic agents will have a far wider field in which to maneuver for peaceful ends

if we have a wide variety of countermeasures.

There are many people in Western Europe who believe that Russia would have used much more active means of bringing the nations of Western Europe into her orbit during the past five years had it not been for her fear of the lead which we possessed in the field of atomic energy. Obviously, it is very difficult to substantiate this viewpoint, but one cannot help wondering what the future will hold if the Russians outstrip us in this field in the near future.

ESTIMATE OF PRESENT RUSSIAN STRENGTH

What effort is required to maintain a lead on the Russians? Varying estimates can be given, depending upon the assumptions one makes about Russian strength. I would estimate that at the present time the Russian economy has a productive capacity about one third that of the United States, and of comparable quality. This figure is based on a number of considerations. Among the most important is the fact that the Russians possessed sufficient modern equipment during the early stages of the war with Germany to halt the German drive. This engagement occurred at a time when Germany was essentially unoccupied on the Western Front and before our material aid to Russia could have been appreciable. The Russians were producing heavy ordnance equipment of excellent quality in appreciable quantities. The estimates of Russian steel production support the same figure. The low standard of living in Russia indicates that a very large fraction of its economy is devoted to the military machine. The fraction is probably well over half; however, even if we adopt this figure, we come to the conclusion that in a purely material way the Russian effort probably is equivalent to that derived from about 15 or 20 per cent of the American economy. The aggregate effort of the West, which is derived principally from United States at present, is less than 10 per cent of the American economy. There is, however, what may be even a more important difference: Military preparation is probably regarded as the most urgent phase of industrial life in Russia at the present time. This attitude has a very important influence on the individuals engaged in the military program since there are very few diversions. It tends to favor both determination and efficiency. There are many indications of the benefit the Russians gain from this psychological factor. For example, there is the great speed with which they developed the atomic bomb. This is comparable to our speed during wartime, and is probably at least five times greater than our rate of advance in developing atomic energy since the end of the war. In fact, the Soviet rate of development in the field seems to be sufficiently greater than ours at the present time, probably mainly as a result of this mental attitude, that there is grave danger that they will surpass us within the next decade. The same is probably true in other fields of military research.



REQUIREMENTS OF OUR ARMS PROGRAM

The improvements which are needed in our arms program do not depend primarily upon an increase in the amount of money spent, although this factor may have to be given more careful consideration. Instead, they depend upon a great increase in the seriousness with which we take the military program and in the amount of imaginative talent which is spent on military research. The first of these must obviously involve the entire public. The great importance of the bombing of Pearl Harbor during the last war resulted as much from the change in attitude of the public toward the international situation as from the fact that more of our production was devoted to the manufacture of weapons. The concentration of imaginative talent involves primarily the scientists who are not now engaged in military work.

Here, the importance of preventing Russia from obtaining hegemony over the remainder of Western Europe should be emphasized from another viewpoint. If Russia were to succeed in this endeavor, she would probably double her industrial strength and military output. Should this state continue undisturbed for any appreciable length of time, such as a decade, our own country would probably be incapable of matching the result.

Conversely, since Western Europe has at least as much at stake in the present crisis as has the United States, it is evident that any and all plans which originate in this country should be closely integrated with those of the nations of Western Europe which in the long run must be willing to make sacrifices for this cause. The issues concern our mutual heritage and mutual future. Moreover, there are innumerable ways in which the somewhat older traditions of Europe and the more recent developments in this country complement one another.

What shall the Physicist do? I believe the time is ripe for physicists, and scientists in general, to devote a much larger fraction of their time to research of military interest in the sphere in which they can be most effective, namely, in that frontier region where a high degree of imagination and specialized knowledge is involved and in which their efforts were so successful during the recent war.

WHY PHYSICISTS HESITATE TO DO MILITARY RESEARCH

Many physicists agree with the foregoing analysis in principle and yet exhibit great caution about becoming more deeply involved in military research at the present time. I would like to examine the factors which account for this reticence.

First, there seems to be a small contingent which feels that perhaps physical scientists will not occupy a principal role in the crisis because the main interest will shift to other fields, such as biology and possibly psychology. By way of a corollary it is suggested that physical scientists should not concern themselves with the situation at this time, but continue with complete emphasis on fundamental research. In a sense it is true that during the last war physicists occupied the prominent position that chemists had held in the first war. However, this does not mean that the role played by chemists was not vital. In fact, even the most elementary considerations provide conviction that the physicist will play a major role in any military program because of his basic concern with quantitative relations between space, mass, and time in all their generality. This will be true even if major applications of biology and psychology are imminent.

THE CONCERN FOR THE ADVANCE OF BASIC SCIENCE

Second, there is the question of the development of fundamental science. There is, particularly among the most gifted scientists, a fear that the ad-

vance of fundamental science will be greatly retarded if military matters receive prominent attention. This matter is made one of particular concern because many scientists spent four or five years on military work during the past decade and fear that another period of this kind will interfere seriously both with their own careers and with the course of fundamental science.

No one can even pretend that fundamental science will be completely unaffected by the diversion caused by placing greater emphasis on military research. The best one can hope for is some form of compromise. Such a compromise can be achieved if the burden for military research is distributed fairly broadly by universal recognition of the need for a leave-of-absence system in which leading academic and industrial scientists are given comparative freedom to devote an uninterrupted period of time in military laboratories. Such leaves could extend for periods between one and three years and could be carried out on a basis of understanding similar to that employed during the war. I believe a program based on extended leave-of-absence is far preferable to an extension of the consulting system or visiting-committee system now in vogue since, as in any other field of intricate research, greatest results are achieved by essentially undivided attention for a period of time. If the burden is adequately distributed through the many academic and industrial institutions in the nation, the fundamental research and training program of no one will be vastly affected. Fortunately, as a result of intensive training, a new generation of scientists has already emerged since the end of the war. This group can aid greatly in distributing the burden.

In connection with the concern about disturbing fundamental science it is probably very important to remember that the devotion of a fraction of the national scientific effort to military research at this time may make it unnecessary to upset academic life completely, at a later date. This, in fact, is one of the very strongest arguments that can be given for the establishment at this time of a program which leaves academic life mainly intact.

THE MORAL ISSUE

Third, there are psychic blocks which arise from ethical and moral issues. Several forms of block exist. First is that based on the fear that the work of the scientist may be abused by those who form national policy. Many scientists feel that there was a grave moral issue involved in the dropping of the second, or Nagasaki bomb, regardless of what issues can be raised in favor of dropping the first bomb. They feel that it may be improper to engage in military research unless they can have assurance that the results of their work will not be misused. Another block is associated with what Oppenheimer has termed the "sense of sin," which a fraction of the scientific community feels because of past association with instruments of war. To those to whom these blocks are serious I offer the following counsel:

The issues at stake in the present conflict, as those during the past war, concern the most important ideals which have been evolved by mankind since the dawn of civilization. At stake is the concept of tolerance in the broadest meaning of the word. I feel it would be highly immoral not to do the best we can to preserve the state in which these ideals represent the principal goal. Who among us will feel sinless if he has remained passively by while Western Culture was being overwhelmed?

In addition, it must be remembered that scientists as a group can have a very great influence in the shaping of national policy if they will use the means open to them. The circumstances surrounding the passage of the McMahon Act furnish adequate proof of this. The fellow-scientists whom we choose as leaders will be represented in many of the great decisions that are to be made. Be certain that the men in whom you place confidence have a high sense of morality. It is also valuable to remember that if we engage in military research during peacetime when the normal channels of public discussion are open, we shall have more freedom to express opinions than during wartime.

THE PROBLEM OF SECRECY

Fourth is the concern about the methods employed to maintain what is normally termed "secrecy." Many scientists feel that the techniques now widely employed to classify scientific information do far more harm than good because they interrupt the free flow of information that should be widely disseminated and provide a completely false sense of security. In addition, there is the fear that security organizations have, on the whole, too little concern for the rights of the individual and will undertake character assassination on grounds which bear little relationship to actual guilt. The simplest way to avoid these difficulties is not to work in fields of military interest. This problem evidently is one that is worth far more space than I have available here. It must suffice to say that it deserves far more attention as a topic of public discussion than it has received to date.

THE LIMITED OUTLET FOR SCIENTIFIC TALENT

This brings me to the fifth and final factor disturbing the minds of scientists who feel a sense of urgency about military research; namely, concern about the existing limitation on the outlets for scientific talent. In order to appreciate this limitation, consider the situation which existed during the recent war. In 1939 the only military research installations in the United States were highly conventional laboratories, associated for the most part with branches of the services. Since they dealt with the most urgent day-to-day problems of the armed services, it was necessary to expand them by a large factor to match the expansion of the services. In addition to this, however, it proved necessary, as at previous times of emergency, to establish entirely new agencies devoted exclusively to new problems. Among these there was need for an organization, basically civilian in structure, to explore the application for military purposes of techniques and fundamental discoveries which had been made in the fields of science since the previous war. It was important that this organization provide the greatest freedom for imaginative thinking. It is evident that the ultimate success of such an organization depended upon its ability to attract the best scientific talent in the nation, upon its ability to place ample facilities at the disposal of this talent, and, perhaps above all, upon its ability to establish and maintain excellent relations with the services so that the two types of organization would be able to combine their individual efforts to form a coherent and useful whole. The success of American scientists in establishing such a structure, namely, the Office of Research and Development, has always struck me as a very remarkable achievement. I would like to comment further upon this achievement from a particular viewpoint.

THE SUCCESS OF THE OSRD

It is by no means obvious that a nation in the midst of a great crisis will establish a successful civilian research organization. The Germans failed miserably; and their defeat is probably due as much to this as to any other single factor. They depended primarily upon more conventional organizations which never had much authority and were never well coordinated. A complex of factors entered into our success—a fortunate choice of leadership, the experience of the British during the darkest hours of 1940, and the almost complete absence of any existing structure with which the new one could be said to be in serious competition. In any event, the resulting organization embodied in an amazing way what I should like to term a pattern that reflects the best in Western Ideals. Although it was outwardly very formal, it contained sufficient flexibility so that there was ample opportunity for all participants to exercise great freedom of initiative without encountering arbitrary censure. Anyone who had a contribution to make could find a place within the structure. The requirements on such personal traits as temperament and conventionality were exceedingly broad. One found a complete spectrum of the scientific world, from brilliant and possibly unstable eccentrics to cautious and exacting conservatives. All could find a place. Moreover, in examining the constituent laboratories or committees of the organization, one found a surprising degree of independence and self-assertiveness. If one adopted a somewhat naive viewpoint, it was easy to regard component organizations, such as the Radiation Laboratory at MIT, as autonomous units employing the means at their disposal in the best way possible, in spite of the fact that there were well-directed lines to Washington. This feature of the OSRD may perhaps be described best by saying that there was a balanced distribution of authority within the organization. Authority was not centered rigidly within a set of offices in Washington, but was distributed wherever it could be employed to best advantage. The basic rules limiting the use of authority were conditioned only by the thought that there was national peril. I believe that this feature of the OSRD determined its success. It is evident that to the unobservant eye an organization possessing this high degree of internal freedom may seem to be chaotic. This is precisely the type of organized chaos which characterizes Western civilization and which has been its greatest strength.

If we examine the opportunities for military research which exist at the present time for a scientist who desires to make a contribution, I believe we will find them vastly limited in comparison with the wartime possibilities. In brief, an organization of the type of the OSRD is almost nonexistent. There are a number of excellent service laboratories which are well staffed and which are carrying out their necessary continuing function in addition to a certain amount of exploratory research. These, however, offer the proper medium of expression for only a limited fraction of scientists. The organizations which resemble most closely the OSRD are the Research and Development Board and the Atomic Energy Commission. The first is intended to coordinate policy and is not a contracting agency, as the OSRD was. As a result, it has at best only limited means and authority to offer the scientist. The AEC comes closer, but it has two drawbacks: Its field of interest is restricted to nucleonics and hence is very narrow compared to that of OSRD; in addition, it exhibits, I believe, a pronounced tendency to confine authority to the Washington offices. It is true that some of the laboratories, most notably Los Alamos, have a sense of autonomy that approaches that of the wartime laboratories; moreover, the support of fundamental research is good. In the main, however, the AEC has approached new fields of applied nucleonics with more caution than the corresponding wartime organizations did. The origin of this caution is based upon a number of factors, but there are probably two principal ones which I should like to comment upon presently. It should be stressed at the start that money is not one of these factors, since the present budget of the AEC is comparable to the wartime budget of the Manhattan District, even making allowance for inflation.

In any case, a physicist who desires to spend several years concentrating on military research at the present time will find the opportunities relatively restricted. He may undertake research in the field of nuclear explosives with something like the wartime sense of autonomy. He will find opportunities of a much more limited type present in the field of nuclear reactors, although it is possible that this field will be removed from the doldrums now that it has been given special cognizance by the AEC, under Hafstad.

He may engage in military planning from an administrative standpoint in a part of the National Military Establishment, such as the RDB. Or he may enter one of the service laboratories and become engaged in work of the continuing type. If his interests lie in these fields, he can probably make a valuable contribution to preparedness. However, these alternatives are not sufficiently broad to make use of the great reservoir of talent that is available or to handle the vast complex of problems that will arise.

THE NEED FOR A NEW AGENCY

We shall not be taking advantage of the great diversity of development which our civilization permits unless the institutions for military research, taken as a whole, reflect this diversity. In particular, I believe we shall not have begun to take our defense with the full seriousness the present international situation merits until the existing agencies have accepted the principle of balance of authority, and until an agency analogous to the OSRD has been evolved and given contracting powers. It is commonly stated that a society founded upon restrictions of individual freedom should not provide a match for a system based upon the principle that individuals should have broad freedom to exercise initiative. In so far as this statement contains truth, it does so only if the free society develops its defenses on the full scale of its diverse culture. Taken as a whole, the institutions for defense should admit of contributions from individuals having talents and temperaments as broad as those found in the best academic institutions.

Our existing military research organizations were established at the end of the war when there was high expectation that we would enter a long period of tranquil peace. In fact, the pressure of this viewpoint found part of its expression in the McMahon Act which, at least as far as the scientific community is concerned, was supported with the conscious thought that our approach to that period of tranquility would be far more certain if the field of atomic energy were treated like any one of a number of fields that are normally administered by civilians during peacetime. A large part of the lack of diverse opportunity for military research arises from this source. We hoped that a crisis of the present nature could be avoided if the United States took the attitude that no crisis would occur in the near

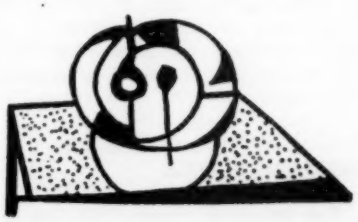
future. Fortunately, there is little doubt that the McMahon Act is flexible enough to be adapted without major revision to the conditions of an emergency. What seems to be needed is principally a reinterpretation of the contents of this Act in the light of the present situation. Perhaps the RDB can be transformed into the equivalent of the OSRD by giving it contracting powers and by placing it under the direction of one of the vigorous wartime scientific leaders who has earned the admiration and trust of the great majority of scientists. By providing the RDB with contracting powers, the groups undertaking top-level planning would have available essentially independent research organizations to complement the work being undertaken in the services: Organizations which would have no vested interests in existing installations and policies and would feel free both to propose essentially new directions of action and to recommend the termination of lines that will probably be ineffective.

CONGRESSIONAL ATTITUDES

What factors will determine whether the McMahon Act is given a new interpretation and whether a new OSRD will be established? The answer clearly lies, in the first instance, in the attitude of Congress. While it is evident that Congress is aware that a grave crisis confronts us, it is also evident that an appreciable component of Congress is not aware of the conditions which must be met if we are to obtain the most from our scientific fraternity. For example, the continued partisan attacks on the top administration of the AEC, on issues which appear absurd to the majority of scientists, has probably done as much to impede the progress of that organization as could a number of well-placed Russian agents. It is a sad fact that the vote of the Joint Committee on Atomic Energy on Senator Hickenlooper's charges was split strictly along party lines. One of the great disadvantages resulting from these ill-founded Congressional attacks is the fact that they have prevented the scientific community from engaging openly in constructive criticism of the AEC.

Can we hope for a change? This hope appears to rest principally upon a change in the attitude of the voting public toward the present crisis. For, ultimately, the atmosphere in Washington will be determined by public opinion. Again, there is little doubt that the public, like Congress, realizes that we are in the midst of a serious international struggle. On the other hand, it has been given far too optimistic a picture of our own superiority relative to Russia. There is still a widespread belief that our industrial talents and capacity are at least a factor of ten better than those of Russia. This viewpoint is based on erroneous, if well-intended, propaganda, a misinterpretation of the reason for the low standard of living in Russia, and far too optimistic reports from many governmental agencies concerning the status of military research in the fields they cover. In addition, there is a general complacency of the public mind which arises understandably from the fact that life in our land is exceedingly pleasant. It may prove necessary to contract our standard of living if we undertake military preparedness with anything like the seriousness that is prevalent in Russia.

One of the most striking characteristics of public opinion in a democracy is the fact that it can undergo relatively abrupt changes, much like the abrupt changes that occur in water when it freezes. Just as water may be supercooled to a temperature below the freezing point for a period of time before freezing begins, public opinion can retain a view that is fundamentally out of keeping with its environment. I believe that American public opinion is in such a supercooled state at the present time and that there will be an abrupt change sometime in the near future if the present crisis continues. In the past, changes of this type have been instituted by disasters such as those which occurred at Lexington, Fort Sumter, and Pearl Harbor. In fact, such examples seem to be the rule rather than the exception. If the impending change in public opinion hinges upon such a disaster, it is clear that events may have advanced to a point where defeat is certain.



THE SCIENTISTS' TASK

It seems to me that the scientists of the United States have an important and continuing task in trying to arouse an awareness in the public mind of the need for much more active international negotiation and much more active military preparedness long before such a disaster can occur. Few groups are in a better position to do this. It is entirely possible that such a disaster will be averted if the proper steps are taken; however, we shall be in a far better position to preserve our institutions if this disaster occurs, in spite of our fervent wish that it may not, if we are prepared.

Perhaps the first great task to be undertaken is that of forming a unified opinion among our own fraternity, for it is evident that we are by no means unified. Many scientists who feel basically all of the sense of urgency I have attempted to describe here are reticent about entering into military research for a period of time, even though they know they could make valuable contributions, because they are uncertain about the general opinion among their fellow-professionals. However, this is not the only reason for developing a unified opinion, even though it is a good one. At the present time the physicists represent a very influential force in the nation. This influence is derived principally from one source: In 1939 and 1940, the majority of physicists who were in positions to make decisions agreed that an urgent crisis was at hand, and, at their own initiative, took the best measures available to them to support Western civilization. Had they not done this, it is doubtful if our opinions would be of much concern to anyone at the present time. Should we fail at this time to exhibit the wisdom which was displayed ten years ago we shall lose, both individually and collectively, an appreciable measure of this opportunity to serve the cause we all agree upon; namely, to provide a peaceful solution to the ills that now afflict the world without losing our intellectual freedom.

UNITED NATIONS ATOMIC ENERGY NEWS

Francis W. Carpenter

THE secret consultations of the Six Sponsoring Powers on control of atomic energy were disrupted January 19, 1950, by a walkout of the Soviet Union delegate in protest against the continued presence in the talks of the representative of Nationalist China.

The walkout was part of the Russian plan of leaving every United Nations organization in which the Nationalist Chinese sat.

When the delegates convened at 11 A.M., Malik immediately made a motion that Dr. H. R. Wei, one of the original delegates on the U.N. Atomic Energy Commission as a representative of China, be excluded.

General A. G. L. McNaughton, of Canada, also one of the original members of the Commission, countered with a motion that Malik's proposal be considered out of order. McNaughton took the position, supported by Jean Chauvel, of France, that the consultants at the table did not have authority to determine their membership since that membership was derived from the Security Council. The permanent membership of the Atomic Energy Commission is made up of the members of the Security Council, plus Canada when Canada is not on the Council.

Wei, acting as chairman, ruled Malik out of order and asked if he challenged the ruling.

Malik replied that no one challenged the right of China as a state to be a member of the Security Council. He said that what was challenged was the participation of the "Kuomintang representative whose presence is harmful to the United Nations as a whole." He insisted on a vote on his motion to exclude Wei.

Wei then spoke as a representative of China. He said that the possibility of a hydrogen bomb made the problem of atomic energy control even more urgent and that any party which refused to continue the talks would bear the responsibility for the consequences.

Wei added that he was the legal representative of China and of its people, a people who had no desire to produce the atomic bomb but were interested in international control of the atom. He said that his people also had a desire to profit from the peaceful uses of atomic energy.

Malik said that every group had a right to determine its membership.

A vote was taken on McNaughton's motion; it was approved, 5 to 1. No vote was taken on Malik's proposal.

Malik thereupon said he would not participate as long as the "representative of the Kuomintang participates." He said the Soviet Union would not recognize as legal any decision or recommendation made by the consultants as long as the "Kuomintang" was present and the Soviet Union was absent.

Malik left the room at 11:55 A.M.

John D. Hickerson, United States Assistant Secretary of State, who had not spoken during the debate on the China question, said he was ready to continue the meeting, even though he regretted the Soviet action. Sir Alexander Cadogan, United Kingdom, agreed in deploring the Soviet departure, especially since the main idea of the talks was to bridge the gap between East and West. He said that the United Kingdom was ready to continue.

Chauvel suggested that the summary record of the meeting be sent by the Secretary-General to all members of the United Nations. He agreed that the five remaining delegates could continue talks but thought it should be made clear that it would be a different procedure. He said that it was quite clear that the consultations of the Six Sponsoring Powers were suspended.

The five delegates decided that Chauvel, whose turn it was to be chairman, could keep the situation under review and call a meeting when the opportunity came. The meeting then adjourned.

FIVE-POWER COMMUNIQUE JANUARY 19, 1950

The following communique was issued by the five remaining consultants:

"The representatives of the permanent members of the Atomic Energy Commission—Canada, China, France, the Union of Soviet Socialist Republics, the United Kingdom, and the United States—held their 14th meeting on Thursday, 19 January.

"At the beginning of the meeting, the representative of the USSR moved that the present representative of China be excluded from participation in these consultations. The representative of Canada moved that the motion of the representative of the USSR be considered out of order, because representation in the group derived from representation in the Atomic Energy Commission, and that, in turn, derived from representation in the Security Council.

"After some discussion the Canadian motion was put to the vote and carried by five votes in favor and one against. The representative of the USSR then declared that he could not continue to participate in the consultations until the present representative of China had been excluded from them. The representative of the USSR then left the meeting.

"The representatives of Canada, China, France, the United Kingdom, and the United States are of the opinion that so long as the Soviet Government refuses to participate in these consultations, it is impossible for them to achieve the primary purpose of the mandate given to the Six Powers by the General Assembly.

"They will, of course, remain in close contact with one another and will meet and consult with each other on such limited objectives as are possible of achievement in the circumstances.

"It was also agreed that the Secretary-General of the United Nations would be requested to transmit to all Members of the United Nations a letter to be forwarded to him by the representatives of Canada, China, France, United Kingdom, and the United States, together with the summary record of the 14th meeting of

the six permanent members of the Atomic Energy Commission."

Hickerson held a press conference after the adjournment. He said he was profoundly convinced that the members of the General Assembly, who last fall instructed the Six Sponsoring Powers to continue the consultations, wanted to see a serious effort made toward agreement on atomic control.

He said he was convinced the Assembly did not want to see such "wholly irrelevant and extraneous matters" as the recognition of Communist China interfere with the talks.

Hickerson said if the vote had gone the other way—if the Nationalist China delegate had been ousted—he was prepared on instructions from the United States government to go ahead with the consultations.

FREDERICK OSBORN'S RESIGNATION

On January 23, 1950, the resignation of Frederick H. Osborn as Deputy United States Representative on the United Nations Atomic Energy Commission, was announced by President Truman. Osborn told reporters that he had been in government service since 1940 and that this was an appropriate time to give more attention to his private affairs. He said that he would remain in a consultative capacity with Warren R. Austin, chief United States delegate, and with Hickerson.

Asked about the prospects of agreement, Osborn said:

"I do not think the Soviet Union will come to agreement on the control of atomic energy until they reassess their relations with the world as a whole and decide that they want to live in a cooperative and friendly world. I feel certain that until that time they are not willing to open up Russia to that minimum extent necessary for real control."

John C. Ross, Deputy United States Representative on the Security Council, was appointed Acting Deputy U.S. Representative on the Atomic Commission. This was the first time since the U.N. Commission was created in 1946 that the United States has not had at Lake Success a full-time Deputy concerned with atomic affairs alone. Ross's appointment is in addition to his other duties on the U.S. Mission here. Hickerson is expected to continue sitting for the U.S. if the Sponsoring Powers meet, with Ross supporting him.

BOOKS

Modern Arms and Free Men. By VANNEVAR BUSH. New York: Simon & Schuster, 1949. Pp. 274. $3.50.

THE MILITARY ASPECTS

IN *Modern Arms and Free Men* democracy is presented with a well-earned dividend. It is good that our system permits such a book to be written, and that it is so well done. It is also lucky for us that it comes out in this time of need.

It is characteristic of Dr. Bush that as soon as it became appropriate, he set forth his views on many of the major issues of our time. The force and clarity of expression derive in part from the author's own habits of thought and pungent phrase, but also from the fact that these ideas and arguments have been generated and tested by sharp debate in the inner councils of Washington for the past decade.

Modern arms have evolved so fast and are so complicated and powerful that it is difficult for the average thinking citizen to arrive at a personal basis for evaluation. In this dilemma there is great need for articulate reports from responsible experts who have been close enough to the firing lines to get first-hand information without also accumulating mental scar tissue and losing objectivity. In my opinion this book puts Dr. Bush in the unscarred (also unscared) group of front line scouts.

Reading *Modern Arms and Free Men* is like visiting with a traditional country doctor who lays down the law as he goes from case to case, but also allows you to sit in the sick room as he treats each patient, and finally gives you a chair at a crackerbarrel argument with Hamilton, Jefferson, Karl Marx, Hitler, and Stalin.

Bush's treatment of the evolution of weapons and systems in World War I and in the static interval from 1919 until the late 1930's highlights the fact that the "quantum jumps" made by science and engineering before and during this period had insufficient impact on military concepts and weapon development.

While I fully agree that radio was of immense importance as "the embryo of great developments" (in applied electronics, radar, proximity fuzes, loran, etc.), I feel that to remark (of radio): "it was useful primarily for communication at sea and to correlate movements in sea battles" (p. 15) is to understate the case heavily. Actually, rapid radio communication revolutionized naval warfare not only in its tangible but also in many of its psychological aspects. No longer was a field commander isolated from the world (and higher authority). In fact, a difficulty arose in separating the wheat from the chaff among the messages that poured in. Incidentally, radio communication created an overlap in the classical military terms "strategic" and "tactical." The visible horizon ceased to be the boundary for tactical maneuver.

In successive chapters, Dr. Bush covers the technical war on land, on the surface of the sea, under the sea, and in the air, and then treats the guided missile and atomic bomb. These technical chapters are stimulating and provide material for argument. Some of his implied and stated conclusions will be argued here.

Marked conservatism is shown in the single paragraph devoted to airborne operations. "As an aid to breakthrough, to reduce casualties and risk in any case where there is control of the air and when the break-through is going to occur in all probability anyway, the airborne assault has its place, and as such an aid it was skillfully used." (p. 33) I prefer the view expressed by Admiral C. M. Cooke, U.S.N. Ret. in the July, 1949, *Foreign Affairs:*

It is not sufficient merely to have air groups available if war starts; they must begin now to get ready for the ground-air tasks that may fall their way fifteen years from now. Years will be required to create an experienced body of ground-indoctrinated air personnel and air-indoctrinated ground personnel and to develop special equipment and methods. This growth will be accompanied by continuously changing tactical concepts, and even changes in strategic concepts, to fit in with the increased mobility and offensive power that our ground-air force will acquire.

Dr. Bush's "strong indication . . . that the defense may again be in the ascendant in land warfare" (p. 33) seems to be based on demonstrated effectiveness of land mines and antitank weapons late in World War II. Similar arguments were once used to "prove" the futility of amphibious operations—Gallipoli, mines, coast defense guns, land-based air. The *aqua regia* which dissolves military obstacles is a mixture of concentrated striking power and mobility. Both of these acids have increased in potency since Hiroshima.

There are several small bones of contention in the discussion of surface sea action.

One paragraph apropos of radar and fire control cites the BISMARCK-HOOD affair and Savo Island in the Solomons, two sea encounters in which the prestige of the British and American navies suffered greatly. As demonstrations of the importance of radar in sea battles, neither case is clear-cut. BISMARCK, with primitive search radar in this daylight affair, needed only good pre-radar fire control and guns to sink HOOD. On the other hand, the United States ships had radar, both search and fire control, at Savo Island, and the Japs had only their "poor" eyes. We were disastrously defeated primarily because the Japs had excellent tactical intelligence that night, while ours failed. This combination gave them tactical initiative and surprise.

"Is there any effective defense against the very high bomber using guided bombs? If there is not, the days of large fighting ships—carriers as well as battleships—are over." (p. 45) In considering this issue, the discussion centers mainly on air-to-surface radar and the guided bomb which "can hardly be made to hit with certainty a confused target such as one building in a city. But a great ship alone on the sea is a clear target to radar, and a clear target for a guided bomb." Radar, its important uses and its limitations, are extensively treated in this book, but *sea return* is only hinted at in a discussion of snorkel detection. Radar pulses are reflected by sea water about as well as visible light is reflected by molten silver. The average wave height from crest to trough is eight feet in the open sea. It follows that from very great altitudes no ship in a seaway is "alone" in a radar beam even if there are no escorts present. To the harassed radar operator the problem sometimes resembles looking for a small white object on a shimmering white sheet. Obviously, there are many cards to be played in this radar game, but the point is that Nature has not stacked the deck against a ship on the ocean, as she has in the case of an airplane with only the sky behind it.

In most of his chapter on war in the air, Dr. Bush excludes jet bombers and atomic bombs from the argument. On this basis he easily concludes that mass bombing by conventional bombers with conventional bombs against a fully alerted jet-fighter defense is probably not worth the candle. He predicts that, "with the guided missile developed to its potentially attainable deadly form some time in the future, it may not even be feasible to carry many atomic bombs successfully to fully defended and alert targets." (p. 56) This prediction is valid only if the speed of the delivery vehicle remains well below that of the intercepting weapons.

In his chapter on war under the sea, Dr. Bush speaks from a background of direct knowledge extending back to World War I. His treatment of submarine and torpedo developments and the increased threat they pose should be read carefully and pondered deeply, for, as he says, "The submarine is one of our greatest potential enemies." As to the answer, "Many of the successful methods of the last war are now obsolete against the truly modern submarine. There is no cure-all. The scientist will not suddenly pull a rabbit out of a hat to reserve all the trends. To cope with the situation we need to be alive to the danger, not lulled into complacence by partial successes—to be forging ahead in a dozen fields of difficult technical effort." (p. 69)

Dr. Bush has seen guided missiles and the atomic bomb conceived, developed, and sent into combat late in World War II. Both required applied science and engineering of a high order, and both have frequently been treated in an entranced, emotional fashion induced by their awesome potentialities. So it is healthy to have an informed, lucid technical analysis of the possibilities and trends in these two fields. His stress on cost of missiles is also healthy. "If we are going to fire a missile at the enemy, we should be very sure before we devote a large amount of manpower and materials to it that it is going to harm the enemy more than it harms us, that the damage it causes will interfere with his ability to continue the struggle more than it costs us from the same point of view." (p. 79)

I have two general cautions to the reader of the technical half of *Modern Arms and Free Men.*

First, the emphasis is heavily on scientific and technical developments as such. Certainly they are exciting and open up terrific possibilities. But realization of these possibilities requires first, *appreciation* of them in all military and engineering echelons, and then solution of thousands of minor problems of human and material adjustment to the new situation. It is cold comfort to have produced a new weapon if it failed in action because the commander or the operator did not understand it.

The second warning has to do with interpretation of a theme that runs through the chapters:

"We can take comfort in the conviction that dictatorship will seldom pioneer, and that when they do the dictator will probably buy gold bricks. . . ." (p. 24)

"The techniques of this (proximity) fuze were just too much for their (Nazi) regimented science, and manufacture of a device as intricate as this was hardly a proper task for slave labor." (p. 99)

A more balanced statement appears later in "Totalitarianism and Dictatorship":

> The weakness of the Communist state resides in its rigidity, in the fact that it cannot tolerate heresy, and in the fact that it cannot allow its iron curtain to be fully penetrated. All these things, vital to totalitarianism whether right or left, are fatal to true progress in fundamental science. They are not nearly so fatal to the application of science, but they are a severe deterrent to even the healthy growth of this along novel lines. (p. 200)

These statements, particularly the last one, are certainly correct in the right context and with the qualifications well understood. However, with the wrong twist, they could be used to justify a smug assumption of superiority primarily by "divine right" of democracy. Continued proof by performance is needed in all of these fields.

The latter half of this book discusses the nontechnical problems of free men. In the chapter called "Threat and Bulwark," Dr. Bush applies the insight of a natural scientist and philosopher

to the current conflict of ideologies and contrasting philosophies of life. The result is fascinating and illuminating.

In his chapter on "Planning," Dr. Bush speaks as one of the major participants in World War II and in postwar planning and direction of applied science in military fields. From his experience he concludes that "we now need an adequate organization in the National Military Establishment for deliberate military planning in all aspects of modern war, not merely the strictly military part of a generation ago." (p. 257)

Dr. Conant, who has seen the same postwar difficulties in obtaining sound solutions to military problems involving science and politics, analyzes the problem in the January, 1950, *Foreign Affairs* and concludes that *technical tribunals* are needed. He says:

As in the judiciary or administrative machinery of government, it would take time to recruit the necessary personnel to man this type of organization, for this is no part-time hit-or-miss job that is being suggested. Laymen who understand science and scientists are familiar with engineering, and engineers rather than technical experts might well prove the most suitable men for this task of refereeing technical disputes.

The Weapons Systems Evaluation Group in the Department of Defense was set up by the late James Forrestal, then Secretary of Defense, after thorough discussions in which Dr. Bush and the Joint Chiefs of Staff took prominent parts. While its mission, ". . . to provide at the request of the Secretary of Defense, the Joint Chiefs of Staff, or the Research and Development Board rigorous, unprejudiced and independent analyses and evaluations of present and future weapons systems under probable future combat conditions," does not include "deliberate military planning," and the word "tribunal" has the wrong connotation for its analyses, it is certainly to be hoped that its evaluations of weapons and weapons systems will provide a sound basis for over-all decisions.

These problems of weapons and freedom are among the most important and difficult of all that we face in this troubled period. In his career for the past decade and now in *Modern Arms and Free Men*, Dr. Bush has played a major part in creating a climate in which real solutions can be reached.

—W. S. PARSONS
Rear Admiral, U.S. Navy

THE POLITICAL ASPECTS

THERE are books which are successful because of their excellence. There are books which are successful for reasons other than their excellence. There are those which are successful because of their lack of excellence. According to the publisher, Dr. Bush's book has been very successful, and it is not hard to find in the emotional needs of the reading public the explanation for the success of a book such as this. It is considerably harder to find in the book's political philosophy—and it is with it that we are here alone concerned—qualities commensurate with its success.

Dr. Bush's book does for the politically troubled listeners of Mr. Kaltenborn what Joshua Liebman's *Peace of Mind* does for the generally troubled listeners to soap operas. It reassures them; it cheers them up; it stimulates their vital energies while putting their intellectual doubts and moral scruples to rest. Certainly, it seems to say, this is not the best of all possible worlds, but it comes mighty close to being it. The problems which confront us in peace can all be solved with skill, enthusiasm, and faith, and of those which face us in war, improved defenses will take care. And Dr. Bush approaches his task of mental pacification with a pretense which must make him appear far superior to the revealed assurance of the preacher or the speculative insight of the philosopher. Dr. Bush speaks as a scientist. He does not look to heaven for a sign, nor does he search in his brooding mind for an answer to the riddle of modern society. His opinions about society and politics are those of a scientist who has examined the known facts and deduced from them verifiable conclusions.

I have evidence that supports the two chief conclusions of this book. I believe, first, that the technological future is far less dreadful and frightening than many of us have been led to believe, and that the hopeful aspects of modern applied science outweigh by a heavy margin its threat to our civilization. I believe, second, that the democratic process is itself an asset with which, if we can find the enthusiasm and the skill to use it and the faith to make it strong, we can build a world in which all men can live in prosperity and peace.
(pp. 2-3)

The impact which this book has had upon a segment of our society, then, results from two factors: the optimistic appraisal of the present and future state of our affairs, and the scientific pretense which supports that evaluation. It is with the scientific character of its analysis that the political philosophy of this book stands and falls.

While with regard to the future we are all guessers, the past and the present are subject to factual examination. It is here that this book spectacularly fails. It has all the qualities of a Fourth-of-July oration. It is always enthusiastic and confident and sometimes eloquent. Its approach is simple, direct, and engaging in its honesty and human sympathy. It is indefatigably moralizing in seeing in the great political conflicts of the age a struggle between good and evil. In its thought it is strictly commonplace, and in its avoidance of anything that might seem novel or even unconventional it does not always avoid the platitudinous and the trite. Its political program reads like a digest of all party platforms and presidential messages since 1933. There is no space here for a detailed analysis of the book's political philosophy. The analysis of its approach to two problems which are necessarily central to its theme will suffice: the conflict between the West and the Soviet Union, and the impact of modern science upon democracy.

Dr. Bush sees the roots of the conflict between the Western world and the Soviet Union exclusively in moral terms.

The agelong contest between those who would build and those who would dominate now crystallizes into a new form. On the one side are those who see in life only a harsh struggle, whose fatalism now rests on the materialistic fallacy that science teaches all there is to know or feel. On the other side are those who have faith that life has meaning, who would follow science where it applies, but reach beyond in aspiration.

Those who oppose the threat are men of good will. They make up the great company which believes in human freedom. It is a varied company, for it includes those who adhere to the great formal religions, those who do not thus adhere but who have faith, and those who order their lives apart from deep religious thinking but who have hope for man and believe he is capable of building a better world.
(p. 186)

Are we then to presume that if only Russia's leaders were "men of good will" the elimination of the ideological conflict would also mean the disappearance of the politico-military struggle? To this question history has given an unmistakable answer. There was a time, lasting from the first partition of Poland in 1772 to the Congress of Berlin in 1878, when Russian power surged toward Central Europe, the Mediterranean, the borders of India,

the Near and Far East, in the name, not of "materialism" and "fatalism," but of the loftiest ideals of Christianity. Did the world stand any less in terror of Russian might, and did it oppose its spread any less strenuously, because of that community of professed ideals? Did Castlereagh, after having subscribed in the Treaty of the Holy Alliance to Alexander I's Christian principles of government, weaken in his determination to keep Russia out of Central and Western Europe and out of the Balkans? The central issue was then what it is today: the threat to the liberties of Europe and of the world emanating from unchecked Russian power. It was then, and has been throughout its history, an axiom of British foreign policy that the hegemony of one nation over the continent of Europe threatens the security of Great Britain and, for that reason, cannot be tolerated. The same axiom has guided American foreign policy from its inception; it has brought it twice into conflict with Germany and is today the essence of the policy of containment. International communism has added to these perennial aspects of Russian imperialism the peculiar problems of internal subversion and the fifth column. As Secretary of State Acheson put it recently: International communism is "the most subtle instrument of Soviet foreign policy that has ever been devised"; the exclusive insistence on stopping communism was "putting the cart before the horse." By paying exclusive attention to the ideological contest, Dr. Bush has missed the real nature of the conflict between the United States and the Soviet Union.

As concerns the relations between science and democracy, the reviewer's task is made easy; for the fundamental political problems to which modern science gives rise in a democratic society are never mentioned in the book. Under the impact of modern science power is continually drifting away from the people and into the hands of oligarchies of different kinds. In the fields of industry and labor the power of individuals and small groups, by virtue of their control over the technological means of production and distribution, has become obvious. Centralized control over the mass media of communication exerts a powerful influence toward conformity and threatens with extinction Mr. Justice Holmes' "competition of the market" where the truth of ideas is to be tested. The legal and institutional safeguards with which the production of atomic energy had to be surrounded is, in itself, a vivid illustration of the concentration of power which is the inevitable by-product of modern technology.

Yet, by taking over control of technological processes which cannot safely be left in private hands, the state itself acquires unprecedented powers which threaten the liberties of the people. In times past the ever-present threat of popular revolution provided the single most effective check upon the arbitrary uses of governmental powers. The monopoly of the most destructive weapons of warfare in the hands of the government has made popular revolutions impossible and has thus enormously increased, in absolute and relative terms, the powers of the government. All these problems, created by modern science, confront democracy with many challenges. To meet them skill, faith, and enthusiasm are indispensable. Yet, without at least the recognition that these problems exist and require solution, and without the wisdom and the critical intelligence to solve them, the advice to apply skill, faith, and enthusiasm is tantamount to whistling in the dark of a technological age full of novel promises and novel threats.

It is characteristic of Dr. Bush's excursion into social and political philosophy that it misses completely the international and domestic problems which can be understood only in terms of power. This failing is the common quality of a trend which has dominated much of Western political thought throughout the nineteenth century and has been definitely discredited only by the Second World War and its aftermath. This Victorian philosophy of politics cherished the comfortable illusion that the element of power in human relations and the very fact of political domination were mere ephemeral deviations from a normalcy where harmony, peace, and good will reigned supreme. These deviations were believed to be due to the faultiness of social institutions, legal arrangements, and economic relations, or, preferably, to the machinations of evil men—i.e., autocrats, aristocrats, the Kaiser, Hitler, the men of the Kremlin. The only thing that was needed to usher in the Golden Age was then to do away with those evil men or to institute some social, legal, or economic reforms and to devise some new gadget of "social engineering."

Dr. Bush revives that dying faith and lends to its revival his great authority, so well deserved in his own field of specialization. By doing so, he does a distinct disservice to the future of democratic thought and democratic institutions in the Western world. For complacency and Victorian optimism are the last things democracy needs and can afford in the face of the challenges of modern science. What democracy needs first of all is the awareness of its own fragility and precariousness, so well recognized in the Western tradition of political thought from Aristotle to *The Federalist*. What democracy needs next is creative thought, as creative as the political thought of the Founding Fathers was for their own day, thought which re-examines and reformulates the eternal verities of democracy in the light of contemporary conditions and devises institutions which are able to cope with the challenges of modern science in response to the popular will.

To that process of wedding modern science to democracy, scientists—theoretical or applied—can make three important contributions: by doing their best in their own chosen fields, as Dr. Bush has done with so eminent success in peace and war, by speaking out when they have something to say, and by keeping silent when they have neither knowledge nor judgment to speak. If this was the point Dr. Bush was trying to make, he has admirably succeeded.

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Dr. Klaus Fuchs

(Continued from page 68)

use of the universally known facts of basic science, as well as of the additional information relayed by its agents. No spying could have enabled a scientifically and industrially backward state to produce an atomic bomb in five, six, or twenty years. It can be granted that Fuchs's reports have accelerated the achievement of the first Soviet bomb by a year, or even two years, but would it have made a decisive difference in the world-political situation, if this bomb had exploded in 1950 or 1951, instead of in 1949?

A second thing which needs to be stated again and again is that, despite Dr. Fuchs and any other secret agents which the Soviet intelligence service might have planted in or around the atomic energy laboratories, the progress of atomic developments in America requires, not tightening, but relaxation of excessive security regulations; not stopping, but wider opening of the channels of communication and cooperation with scientists in Britain and other countries.

Ape and Essence. By ALDOUS HUXLEY. New York: Harper & Brothers, 1948. Pp. 205. $2.50.

THIS brilliant satirical obituary of humanity portrays Southern California after the Third World War. What follows that event, as here depicted in the form of a grotesque movie script, is worse than the sufferings of war itself, as it is worse for men to live as beasts than to die as men. The survivors bowing to Belial in a travesty of Christian cult; the eunuch-rulers; the sacrificial spearing of monster-babies, twisted-born through sub-atomic radiation; the heating of bakeries with the books of dead civilization; the public mass-fornications; the merry gigglings at torture done for the pleasure of torturing—all these things are put before us with a skillful lightness, as if the writer were fixing the *risus sardonicus* upon extinct mankind. For this is the extension of that evil of wars yet to come of which atomic scientists have been telling us since Hiroshima. The scientist may lead us to the edge of the Pit and bid us look, but it is the poet who can show us what there is to see.

But the Pit here described is not a simple crater dug by an atomic bomb. If one reads this swift, startling tale for its meaning, one finds not a mere warning against a war with the new weapons, but a fanciful "extrapolation" of the badness currently notable in civilization. The bizarre, evil world Huxley imagines is still in some part the world that was there before "the Thing." It is still Hollywood, still Wilshire Boulevard, that the reader recognizes in this wild, exaggerated degradation. Huxley is talking to the cities of the plain.

The Arch-Vicar is proving to Dr. Poole, who has ventured to California on a rediscovery expedition from New Zealand (which "the Thing" did not destroy) that there is a Providence of evil in man's affairs. "Even without the atomic bomb, Belial could have achieved all His purposes. A little more slowly, perhaps, but just as surely, men would have destroyed themselves." And the two principal corrupting ideas? "Progress and Nationalism . . . . the longer you study modern history, the more evidence you find of Belial's guiding hand." In Huxley's view of man's downfall, it began long before the Bomb, and involved, importantly, the abandonment of material power to the ape in man. After that mistake, "Ends are ape-chosen; only the means are man's." The scientist is a central and miserable figure in this sardonic myth. Because Science thought of itself as a mere neutral means, or, with deceptively false harmlessness, a searcher for the Truth, unconcerned with other ends, Science appears in the prologue of Huxley's movie script as two Albert Einsteins led on leashes by baboons. And, having arranged to have the Einsteins themselves forced by the apes to push the buttons of the Third World War (to Bach on the sound track), Huxley quotes Pascal: "We make an idol of truth; for truth without charity is not God, but his image and idol."

Discussing literature in the first half of the twentieth century (in the *New York Times Book Review* of January 15), Lewis Mumford remarks that the writers of this period "have discovered, in man's lower depths, the forces that have brought on the series of catastrophes that have marked our time," and "write without love of a life that is unlovable." The remark is recalled when one feels the lack of all love for life or humanity in this tale of Huxley's. The subject is the utter corruption of man; and in the treatment of this awful subject man

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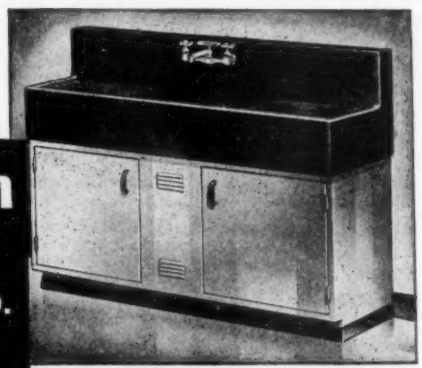

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appears as a sort of silly ass. Worse still, Huxley turns out a bright, surprising picture of this corruption in such a gaily biting style as to suggest that he rather enjoys the spectacle. In a Jeremiah there must be dignity. "Know therefore, and see that it is an evil thing and bitter, that thou hast foresaken the Lord thy God." Not just light entertainment.

Mumford, in the article mentioned, calls upon the writer who will come to find within himself a wholeness that is lacking in society. "For the writer is an interpreter of possibilities." Aldous Huxley is much more of a creator than are those recent writers of second or third rate who are content merely to record the disintegration. Huxley does strive to show us where we went after false gods, and he does create something of a possibility of a future. But the future he creates is a witty little picture of man's fall. If the book is to be read for an intuition as to how men may turn their great means to good ends, not much will be found in it. The book closes in a manner conventional alike in movie scripts and in the literature of romantic science fiction. Dr. Poole and a surviving young female Californian, having rediscovered love with the aid of some lines of Shelley's, escape together across the Mojave Desert to a friendly tribe up near Berkeley. The rocket-ship to Venus! The long climb back to Shangri-la! But the situation of mankind today is not so simple. We are all here together on a closed planet with the apes in control of the factories for making "synthetic glanders," or what not, and must deal with the ape within ourselves as we must find a way to take the paw off the push-button. In this book there is neither advice as to what to do about producing hydrogen bombs nor new strength of spirit. Whether this vision of where we are going, couched in the lightly grim form in which Huxley has written it, may help to stir the mind and the profound impulses of man's human essence, may be doubted.

—ROBERT REDFIELD
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This I Do Believe: An American Credo. By DAVID E. LILIENTHAL. New York: Harper & Brothers, 1949. Pp. 208. $2.50.

A "PRACTICAL IDEALIST" sounds like a self-contradictory person. But such a person does exist, and he reveals himself here in his own philosophy of life and politics. It is refreshing to find a practicing public servant set forth his fundamental beliefs for all to see. [Further, it is heartening to read of the faith in America and in her people and institutions by the one man who knows most intimately the destructiveness of modern atomic warfare.]

Idealism and faith are perhaps the two most evident elements in David E. Lilienthal's democratic credo, *This I Do Believe.* Here is a positive approach, to the future, an idealistic approach, tempered by the experiences of some twenty years as a public servant. His belief is that the future of America and of democracy rests upon the response of the individual to the demands of self-government.

In atomic energy Mr. Lilienthal sees the opportunity for a brilliant future. He recognizes the inherent contradiction between the demands of freedom in a democracy and the needs of restriction for security. He contends that an intelligent and alert public will be required to maintain the proper balance between security and freedom but that such an achievement is possible.

Finding it impossible to turn back from the problems that atomic energy places before us, Mr. Lilienthal calls upon us to look forward and accept the challenge. "In the widening knowledge of the atom we have the means for making our time one of the two or three most vital, most intense, and stimulating periods of all history. In the atomic adventure we sight one of those great mountain peaks of history, a towering symbol of one of the faiths that makes man civilized, the faith in knowledge. I look forward to atomic development, not simply as a search for new energy, but more significantly as a beginning of a period of human history in which this faith in knowledge can vitalize man's whole life."

He earlier states that "greater knowledge about the world will . . . be the keynote of the immediate future. But greater knowledge alone will not be enough. There must also be greater love and understanding among men. And there must also be greater faith in humankind and in the purposes of the Creator of the Universe. Knowledge, love, faith—with these three, the Atomic Age, the age in which we live, can become an age of mercy, of joy, and of hope, one of the blessed periods of all history."

—DAVID PHILLIPS

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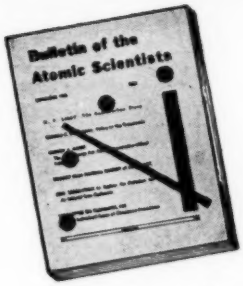

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